

Chalimbana University

DIRECTORATE OF DISTANCE EDUCATION

BHT 1201: FOOD SCIENCE AND NUTRITION IN THE HOSPITALITY INDUSTRY

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P/B E1

Chongwe

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Module Overview

This module discusses food sources, nutrients and the nutritional disorders faced by the people of Zambia. The recommended dietary goals will also be discussed.

Rationale/ Background

This module aims to provide you (student) with basic knowledge and skills in Food Science and Nutrition. You will explore the various categories of where food comes from and their nutritive value as well as the nutritional disorders which may be caused due to insufficient or excess in takes of nutrients.

Module Outcomes

At the end of this module, you are expected to:

* Explain terms associated with food Science and Nutrition
* Categorize food according to their sources
* Classify nutrients and there deficiency diseases
* Analyze the recommended dietary goals

Aim

The aim of this module is to equip you with foundation knowledge of Human nutrition.

Study Skills

As a distance student, you should not expect to sit behind the chair and learn everything from the lecturer. You are expected to find time to study as an individual or as a group from your area or nearby areas. The lecturer is there as a guide each time you come for contact sessions. Take advantage of the presence of lecturers and fellow students to cover as much work as possible during contact sessions.

Time Frame

This course will be covered in three terms of one academic year.

Need Help

Lecturers in the department of Hospitality Management and Tourism will be there to assist you during contact sessions. You are free to call them away from campus for needed clarifications as you study this module.

List of Equipment needed for this Module

* Projector
* Laptop

Required Resources

* Chart on food sources, food groups, food pyramid/my healthy plate and nutritional disorders
* Some unfamiliar food sources

Assessment

Continuous Assessment

 (Assignments, Practicum, presentations, Tests/Quizes) 50%

Final Exam 50%

Total 100%

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Summary

This module’s emphasis is on the sources of food as it will lay a good foundation on identification of sources of various nutrients and recommended dietary goals.

## UNIT 1

## FOOD AND FOOD SOURCES

Introduction

This unit introduces you to food sources from both plants and animals. It has also briefly looked on what organic foods are and why it is important to take such foods.

##### Specific Outcomes

After studying this unit, you are expected to:

* Explain definition terms in this unit
* Identify plant and animal sources
* Classify animal and plant sources of food
* Discuss organic foods and their importance

Time frame

* Self study: 2 hours
* Lecture contacts: 3 hours

### **Required Resources**

* Chart on food sources
* Some unfamiliar food sources
* Projector and Laptop

FOOD SOURCES

Where does food come from?

 Food is usually of [plant](http://en.wikipedia.org/wiki/Plant%22%20%5Co%20%22Plant) or [animal](http://en.wikipedia.org/wiki/Animal%22%20%5Co%20%22Animal) origin, and contains essential [nutrients](http://en.wikipedia.org/wiki/Nutrient%22%20%5Co%20%22Nutrient), such as [fats](http://en.wikipedia.org/wiki/Fat%22%20%5Co%20%22Fat), [proteins](http://en.wikipedia.org/wiki/Protein_%28nutrient%29%22%20%5Co%20%22Protein%20%28nutrient%29), [vitamins](http://en.wikipedia.org/wiki/Vitamin%22%20%5Co%20%22Vitamin), or [minerals](http://en.wikipedia.org/wiki/Mineral%22%20%5Co%20%22Mineral). Historically, people secured food through two methods: [hunting and gathering](http://en.wikipedia.org/wiki/Hunter-gatherer%22%20%5Co%20%22Hunter-gatherer), and [agriculture](http://en.wikipedia.org/wiki/Agriculture%22%20%5Co%20%22Agriculture). Today, most of the food is supplied by the [food industry](http://en.wikipedia.org/wiki/Food_industry%22%20%5Co%20%22Food%20industry).

PLANT SOURCES



CLASSIFICATION OF PLANT SOURCES

1. Leafy vegetables
* Rape,
* Chinese cabbage
* [Spinach](http://en.wikipedia.org/wiki/Spinach%22%20%5Co%20%22Spinach)
* [Lettuce](http://en.wikipedia.org/wiki/Lettuce%22%20%5Co%20%22Lettuce)
* Kalembula
* Herbs (thyme, parsely, rosemary, sage, mint)
* Chibwabwa
* Cassava leaves
1. Stem vegetables
* Celery
* Some spices(cinnamon)
* Sugarcane
* Zha cai
* Asparagus
* Cardon
* Repini
* Leeks
* [bamboo](http://en.wikipedia.org/wiki/Bamboo%22%20%5Co%20%22Bamboo) shoots
1. Flower / [Inflorescence vegetables](http://en.wikipedia.org/wiki/Category%3AInflorescence_vegetables%22%20%5Co%20%22Category%3AInflorescence%20vegetables)
* [Globe artichokes](http://en.wikipedia.org/wiki/Globe_artichoke%22%20%5Co%20%22Globe%20artichoke)
* [Broccoli](http://en.wikipedia.org/wiki/Broccoli%22%20%5Co%20%22Broccoli) and other vegetables such as
* [Cabbage](http://en.wikipedia.org/wiki/Cabbage%22%20%5Co%20%22Cabbage) or
* [Cauliflower](http://en.wikipedia.org/wiki/Cauliflower%22%20%5Co%20%22Cauliflower)).
1. Cereals
* Wheat
* Corn (maize)
* Rice
* Barley
* Spelt
* Sorghum
* Rye
* Millet
* Oats
1. Legumes and pulses
* Beans
* Lentils
* Peas
* Chick peas
* Cow peas
* Monkey nuts seeds
* Nuts
* Brazil nuts
* Around nuts / peanuts
* Hazel nuts
* Pine nuts
* Chest nuts
* Walnuts
* Almond nuts
* Cashew nuts
* Coconut
* Monkey nuts

### Seeds - are typically high in [unsaturated fats](http://en.wikipedia.org/wiki/Unsaturated_fat%22%20%5Co%20%22Unsaturated%20fat) and, in moderation, are considered a [health food](http://en.wikipedia.org/wiki/Health_food%22%20%5Co%20%22Health%20food), although not all seeds are edible. Large seeds, such as those from a [lemon](http://en.wikipedia.org/wiki/Lemon%22%20%5Co%20%22Lemon), pose a choking hazard, while seeds from [cherries](http://en.wikipedia.org/wiki/Cherries%22%20%5Co%20%22Cherries) and [apples](http://en.wikipedia.org/wiki/Apple%22%20%5Co%20%22Apple) contain [cyanide](http://en.wikipedia.org/wiki/Cyanide%22%20%5Co%20%22Cyanide) which could be poisonous only if consumed in large volumes. [Seeds](http://en.wikipedia.org/wiki/Seed%22%20%5Co%20%22Seed) of plants are a good source of food for animals, including y plants and plant parts are eaten as food and around 2,000 plant species which are cultivated for food. Many of these plant species have several distinct [cultivars](http://en.wikipedia.org/wiki/Cultivar%22%20%5Co%20%22Cultivar) humans, because they contain the nutrients necessary for the plant's initial growth, including many healthful fats, such as [Omega fats](http://en.wikipedia.org/wiki/Omega-3%22%20%5Co%20%22Omega-3). In fact, the majority of foods consumed by human beings are seed-based foods. Edible seeds include [cereals](http://en.wikipedia.org/wiki/Cereal%22%20%5Co%20%22Cereal) ([maize](http://en.wikipedia.org/wiki/Maize%22%20%5Co%20%22Maize), [wheat](http://en.wikipedia.org/wiki/Wheat%22%20%5Co%20%22Wheat), [rice](http://en.wikipedia.org/wiki/Rice%22%20%5Co%20%22Rice), [legumes](http://en.wikipedia.org/wiki/Legume%22%20%5Co%20%22Legume) ([beans](http://en.wikipedia.org/wiki/Bean%22%20%5Co%20%22Bean), [peas](http://en.wikipedia.org/wiki/Pea%22%20%5Co%20%22Pea), [lentils](http://en.wikipedia.org/wiki/Lentil%22%20%5Co%20%22Lentil), and [nuts](http://en.wikipedia.org/wiki/Nut_%28fruit%29%22%20%5Co%20%22Nut%20%28fruit%29). [Oilseeds](http://en.wikipedia.org/wiki/Oilseed%22%20%5Co%20%22Oilseed) are often pressed to produce rich oils - [sunflower](http://en.wikipedia.org/wiki/Sunflower%22%20%5Co%20%22Sunflower), [flaxseed](http://en.wikipedia.org/wiki/Flaxseed%22%20%5Co%20%22Flaxseed), [rapeseed](http://en.wikipedia.org/wiki/Rapeseed%22%20%5Co%20%22Rapeseed) (including [canola oil](http://en.wikipedia.org/wiki/Canola_oil%22%20%5Co%20%22Canola%20oil)), and [sesame](http://en.wikipedia.org/wiki/Sesame%22%20%5Co%20%22Sesame), Some spices, Celery seed .Pumpkin seeds.

1. Root vegetables
* Carrots
* Beetroots
* Some spices
* Parsnips
* Turnips
* Chicory
* Kohrabi
* Radishes
* Swede(rute bagas)
* Daikon
* Celeriarc
* Chayote,
* Busala
* Some spices(ginger, turmeric)
1. Tubers
* Sweet potatoes
* Irish potatoes
* Jerusalem artichoke
* Cassava
* Taro
1. Bulb vegetables
* Garlic onions
* Onions
* shallots
1. Fruit vegetables
* Some spice (cayenne)
* Peppers (red green, white, black, yellow)
* Tomatoes
* Egg plants
* Impwa (wild egg plants)
* Zucchini
* Okra (lady finger)
* Pumpkins
* Cucumber
* Squashes
* Beans
* Peas
1. Fruits –[Fruits](http://en.wikipedia.org/wiki/Fruit%22%20%5Co%20%22Fruit) are the ripened ovaries of plants and there are various groups of fruits:
2. Citrus fruits
* Oranges (bitter oranges, blood oranges, mandarin oranges , bengamot oranges , hyuganatsu oranges, sweet oranges navel oranges , tachngelo light fruit kumquart , valence oranges , temple oranges.
* Grape fruits
* Lemons (big and yellow)
* Limes (green and small)
* Buddhas hand
1. Hard fruits ( pomes) - have a long shelf life and transports more easily and are characterized with a smooth skin covering fleshy area surrounding the core
* Apples
* Pears
* Quince
* Kiwi
1. Stone fruits(drupes) - contain a single seed surrounded by a fleshy, juicy edible portion
* .peaches
* Nectarines
* Apricots
* Sweet cherries
* Plums
* mangoes
1. Berries - pulpy and succulant with tiny seeds imbedded in the flesh and are fragile.
* Black berries common in Zambia)
* Blue berries(blue in colour)
* Cranberries
* Strawberries
* Grapes-grow in bunches (green red and purple)
* Goose berries
1. Melons
* Casaba melons
* Persian melons
* Cantaloupe melons
* Cranshaw melons(crossbreed of casaba and Persian)
* Water melon
* Honey dew
1. Tropical fruits
* Banana(yellow in colour}
* Plantains (bigger than bananas and are not eaten raw but boiled, baked or fried).
* Mango
* Pomegranate
* Pawpaw
* Avocado
* Pineapples
* Dates
* Figs
1. Dried fruits
* Sultanas (dried seedless grapes).
* Raisins (dried grapes)
* Currants (dried berries of small seedless grape variety.
* Dates
* Prunes (dried plams)

ANIMAL SOURCES

Animals are used as food either directly or indirectly by the products they produce. [Meat](http://en.wikipedia.org/wiki/Meat%22%20%5Co%20%22Meat) is an example of a direct product taken from an animal, which comes from [muscle](http://en.wikipedia.org/wiki/Muscle%22%20%5Co%20%22Muscle) systems or from [organs](http://en.wikipedia.org/wiki/Organ_%28anatomy%29%22%20%5Co%20%22Organ%20%28anatomy%29).

CLASSIFICATION OF ANIMAL SOURCES

* 1. Red meat- dark colored meat with more myoglobin
* Beef (older cattle meat}
* Veal (calf meat)
* Lamb (young sheep meat)
* Mutton (older sheep meat)
* Game meat (Kudu, Lechew, Buffalo, Warthorg)
* Darker birds meat
	1. White meat- light colored meat with less myoglobin
* Poultry (chicken pigeons turkeys goose ducks ducks, doves, quails guine fowls etc)



* Pork is sometimes classified as white meat or red meat because it has less myoglobin than meat and more myoglobin than chicken. However it falls on the side of red meat because it is a livestock product like beef. It is important to note that white meat is considered to be more healthy than red meat
	1. Fish- fish has less myoglobin and falls under white meats. It has 3 types
* Oily fish - have more fat of about 5% in their flesh:
* Mackerel,
* Herrings,
* Pilchards,
* Sprats,
* Sardines
* Salmon
* White fish –have less 5% fat in their flesh which makes them appear white, but have oil in their liver:
* halibut,
* cod,
* whiting,
* coley
* maize,
* haddock,
* sole
* Shell fish small
* Molluscs (small soft bodied sea animals which live inside the hard shell: coccless, mussels, winkles.
* Crustaceans - soft bodied jointed sea animals covered by a hard protective crust or external skeleton: lobster, crab, shrimps.

OTHER SOURCES OF FOOD

1. Animal products - Food products produced by animals include [milk](http://en.wikipedia.org/wiki/Milk%22%20%5Co%20%22Milk) produced by [mammary glands](http://en.wikipedia.org/wiki/Mammary_glands%22%20%5Co%20%22Mammary%20glands), which in many cultures is drunk or processed into [dairy products](http://en.wikipedia.org/wiki/Dairy_product%22%20%5Co%20%22Dairy%20product) (cheese, [butter](http://en.wikipedia.org/wiki/Butter%22%20%5Co%20%22Butter), etc.). In addition, birds and other animals lay [eggs](http://en.wikipedia.org/wiki/Egg_%28food%29%22%20%5Co%20%22Egg%20%28food%29), which are often eaten, and [bees](http://en.wikipedia.org/wiki/Bee%22%20%5Co%20%22Bee) produce [honey](http://en.wikipedia.org/wiki/Honey%22%20%5Co%20%22Honey), from flowers, which is a popular sweetener in many cultures. Some cultures [consume blood](http://en.wikipedia.org/wiki/Blood_as_food%22%20%5Co%20%22Blood%20as%20food), sometimes in the form of [blood sausage](http://en.wikipedia.org/wiki/Blood_sausage%22%20%5Co%20%22Blood%20sausage), as a thickener for sauces, or in a [cured](http://en.wikipedia.org/wiki/Curing_%28food_preservation%29%22%20%5Co%20%22Curing%20%28food%20preservation%29), [salted](http://en.wikipedia.org/wiki/Salting_%28food%29%22%20%5Co%20%22Salting%20%28food%29) form for times of food scarcity, and others use [blood](http://en.wikipedia.org/wiki/Blood%22%20%5Co%20%22Blood) in stews such as [jugged hare](http://en.wikipedia.org/wiki/Jugging%22%20%5Co%20%22Jugging).
* Eggs
* Milk
* Milk products (butter, cream, cheese, yoghurt).
1. Edible insects
* Caterprillars
* Flying ants
* Grashopers
* Locusts

Some foods not from animal or plant sources include various edible [fungi](http://en.wikipedia.org/wiki/Fungi%22%20%5Co%20%22Fungi), especially [mushrooms](http://en.wikipedia.org/wiki/Mushroom%22%20%5Co%20%22Mushroom). Fungi and ambient [bacteria](http://en.wikipedia.org/wiki/Bacteria%22%20%5Co%20%22Bacteria) are used in the preparation of [fermented](http://en.wikipedia.org/wiki/Fermentation_%28food%29%22%20%5Co%20%22Fermentation%20%28food%29) and [pickled](http://en.wikipedia.org/wiki/Pickled%22%20%5Co%20%22Pickled) foods like [leavened](http://en.wikipedia.org/wiki/Baker%27s_yeast%22%20%5Co%20%22Baker%27s%20yeast)[bread](http://en.wikipedia.org/wiki/Bread%22%20%5Co%20%22Bread), [alcoholic drinks](http://en.wikipedia.org/wiki/Alcoholic_drinks%22%20%5Co%20%22Alcoholic%20drinks), [cheese](http://en.wikipedia.org/wiki/Cheese%22%20%5Co%20%22Cheese), [pickles](http://en.wikipedia.org/wiki/Pickled_cucumber%22%20%5Co%20%22Pickled%20cucumber), and [yogurt](http://en.wikipedia.org/wiki/Yogurt%22%20%5Co%20%22Yogurt). Another example is [blue-green algae](http://en.wikipedia.org/wiki/Blue-green_algae%22%20%5Co%20%22Blue-green%20algae) such as [Spirulina](http://en.wikipedia.org/wiki/Spirulina_%28dietary_supplement%29%22%20%5Co%20%22Spirulina%20%28dietary%20supplement%29). Inorganic substances such as [salt](http://en.wikipedia.org/wiki/Salt%22%20%5Co%20%22Salt), [baking soda](http://en.wikipedia.org/wiki/Sodium_bicarbonate%22%20%5Co%20%22Sodium%20bicarbonate) and [cream of tartar](http://en.wikipedia.org/wiki/Potassium_hydrogen_tartrate%22%20%5Co%20%22Potassium%20hydrogen%20tartrate) are used to preserve or chemically alter an ingredient.

FOOD CHOICES

Some cultures and people do not consume meat or animal food products for cultural, dietary, health, ethical, or ideological reasons. [Vegetarians](http://en.wikipedia.org/wiki/Vegetarian%22%20%5Co%20%22Vegetarian) choose to forego food from animal sources to varying degrees. [Vegans](http://en.wikipedia.org/wiki/Vegan%22%20%5Co%20%22Vegan) do not consume any foods that are or contain [ingredients](http://en.wikipedia.org/wiki/Ingredients%22%20%5Co%20%22Ingredients) from an animal source.

CULTIVATION OF FOOD

Organic Foods

According to Whole foods (2003) describes organic foods as those that are grown under the restrictions of usage of pesticides, herbicides and fungicides to control plant pests. Fertilizers for plant growth is also restricted, but instead organic farming uses animal and crop waste, botanical and biological or non-synthetic pest controls and allowed synthetic materials that can be broken down quickly by oxygen and sunlight. Synthetic material is not allowed in organic farming. A synthetic material is a substance that is formulated or manufactured by a chemical process or by a process that chemically changes a substance extracted from a naturally occurring plant, animal or mineral source.

Furthermore organic farming uses specific methods to minimize air, soil, and water pollution. Production methods such as crop rotation, tillage and cultivation practices, cover crops and natural products such as natural fertilizers, and pesticides are used in organic farming. Therefore organic production can be defined as an ecological production management system that promotes and enhance biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. U.S.A regulations require that organic foods are grown without synthetic pesticides, growth hormones, antibiotics, modern genetic engineering techniques including GMO crops, chemical fertilizers or sewage.

Activity

Ask yourself or a colleague the following questions

1. What is Food?
2. Why do people eat food?
3. Why is food important?
4. Why is it important to eat organic foods?
5. What makes organic foods different from other foods?

### **Unit Summary**

In this unit you have acquired knowledge on the various sources of food obtained from the two main groups of the animal and plant kingdom. Various groups of food sources have been further analyzed.

Review Assessment

* How does the knowledge of food sources contribute to the understanding of nutrition?
* How different is red meat from white meat?
* Distinguish oily fish from white fish
* Outline the nutritive value of the following food sources:
* Spinach
* Cauliflower
* Edible insects
* Mangoes
* Cucumbers
* Melons

Assignment

* Make a booklet with attractive pictures showing the sources of foods as per their categories.

## UNIT 2

NUTRIENTS

Introduction

This unit introduces you to Nutrients which include the two main classes of nutrients thus: macronutrients and micronutrients. Macronutrients include Carbohydrates, proteins, fats and oils.While Vitamins and Mineral elements will be discussed under micronutrients. The first categoryof nutrient to be discussed in this unit will be macrc-nutrients.

##### Specific Outcomes

After studying this unit, you are expected to:

* Explain common terms used in nutrition
* Identify the two classes of nutrients
* Describe chemical composition of macro and micronutrient
* Classifyf macro and micronutrient
* Discuss properties of f macro and micronutrients
* Dietary sources and functions macro and micronutrient
* Discuss excess and deficiency of macro and micronutrient

Time frame

* Self study: 2 hours
* Lecture contacts: 3hours

Required Resources

* Chart on food sources of various nutrients, food groups, food and nutritional disorders
* Projector
* Laptop

### **Definitions of Terms**

What is Food Science?

* Food science is the study of the physical, biological, and chemical makeup of food; the causes of food deterioration; and the concepts underlying food processing.
* Food scientists and technologists apply scientific disciplines including chemistry, engineering, microbiology, and nutrition to the study of food to improve the safety, nutrition, wholesomeness and availability of food
* Dietetics: This is the interpretation and communication of the science of nutrition so that people can make informed and practical choices about food and lifestyle, in both health and disease. The dietician is specific to helping people with different ailments in relation to their diet and prevention of various ailments through diet. Part of a dietician's course includes both hospital and community settings. The majority of dietitians work in health care, education and research, while a much smaller proportion also work in the food industry. A dietician must have a recognized degree (B.Sc. or M.Sc), or postgraduate degree in nutrition and dietetics to work as a dietician.
* Nutrition: This is the study of nutrients in food, how the body uses nutrients, and the relationship between diet, health and disease. A nutritionist looks at all age groups in understanding food and its nutrients as well as functions to maintain health of the public. Major food manufacturers employ nutritionists and food scientists. Nutritionists may also work in journalism, education and research. Many nutritionists work in the field of food science and technology.
* Nutrients – Chemical molecules or substances found in food which the body uses to function properly
* Food – anything solid or liquid which when eaten or drunk provides the body with nutrients needed to sustain life.
* Under- nutrition – an insufficient total intake of nutrients
* Diet – the food that a person normally eats every day e.g slimming diet, low fat diet
* Malnutrition – an incorrect or unbalanced intake intake of nutrients
* Over- nutrition- excess intake of nutrients more that which the body requires
* Deficiency- Symptoms or diseases due to lack of sufficient intake of nutrients

Why is nutrition important?

Nutrition is present in all processes of life. Right from the very moment the sperm fertilizes an egg, through fetal development in the uterus, to the birth, human growth, maturity, old age, and eventually death. Even after death the human body serves as nutrition for other organisms. Anything that involves life and chemical or biochemical movement has nutrition as its core because of dependence on energy.

NUTRIENTS

CLASSIFICATION OF NUTRIENTS

Nutrients are classified under two main classes’ **macronutrients** and **micronutrients.** Macronutrients include: proteins, carbohydrates, fats and lipids. While micronutrients include: minerals and vitamins. All in all there five main groups of nutrients **proteins,** **fats,** **carbohydrates,** **vitamins** and **mineral elements.** **Water** and **dietary fiber** are vital substance though not nutrients.

MACRONUTRIENTS

## CARBOHYDRATES

Carbohydrates are a group of nutrients important in the diet as a major source of energy. They contain the elements Carbon (C) Hydrogen (H) and Oxygen (O). They are produced in plants by the process of photosynthesis from carbon dioxide (CO2) from the air and water (H2O) from the soil in the presence of chlorophyll. Chlorophyll is the green pigment in leaves, which absorbs energy from the sunlight and enables the plant to build up CHOs from the carbon dioxide and water. We as human beings obtain CHOs by including plant foods in the diet

There are three main classes of carbohydrates

1. Monosaccharide ( simple sugars)
2. Disaccharides (double sugars)
3. Polysaccharides( many sugars)

**Monosaccharide’s**

Monosaccharide has single units of simple sugars on which other carbohydrates are built. They are soluble in water and of different sweetness. There three examples of monosaccharide:

* Fructose
* Glucose
* Galactose

Glucose

* Glucose is found in varying amounts in fruits and vegetables. Fruits have large amounts of glucose such as grapes, pineapples and oranges. Most vegetables have smaller amounts like peas, carrots, cabbage etc. Glucose is also found in blood but in minute qualities. Commonly known as blood sugar, glucose serves as an essential energy source for all body activities. Its significance in nutrition is tremendous. No function can be carried out in the body without energy. Glucose is one of the sugars in every disaccharides. One of the polysaccharides, starch, is the chief food source of energy while glucose is a major form of energy in the body.

Fructose

* fructose, chemically similar to glucose but with different arrangement Fructose is the sweetest of the sugars. It found together with glucose in many fruits and honey. Ribose is a sugar which is a constituent of nucleosides and several vitamins and enzymes

Galactose

* The third and final monosaccharide to be considered is galactose, also similar in structure with glucose but does not exist freely in food. It is produced when lactose, a disaccharide is broken down during digestion. Galactose has the same number and kinds of atoms as glucose and fructose but arranged differently. We will now proceed to talking about disaccharides. Remember disaccharides are also sugars.

Disaccharides

There are 3 main types of disaccharides:

* sucrose
* lactose
* maltose

Pairs of monosaccharides combine to form disaccharides, with the elimination of water molecule in a condensation reaction.

* Sucrose = Glucose + Fructose
* Lactose = Glucose + Galactose
* Maltose = Glucose + Glucose

Sucrose

* This is the ordinary household sugar, produced by the condensation reaction of glucose and fructose. Sugar cane and beet sugar contain relatively large quantities of sucrose. These are therefore used in sugar extraction.

Lactose

* This sugar is produced by the condensation reaction of glucose and galactose.

Maltose

* Maltose is formed from the condensation reaction of 2 glucose molecule. Maltose is produced whenever starch breaks down- as it happens when seeds germinate and in humans during carbohydrate digestion. It also occurs during the fermentation process that yields alcohol. Having learnt what sugars are, let us now talk about their properties.

**Polysaccharides**

Formed on a varying of monosaccharide units – poly (many), they are usually insoluble in cold water and are tasteless. Starch, glycogen. Pectin and Cellulose are examples of polysaccharides.

PolysaccharidesPolysaccharides are condensation polymers of monosaccharides, i.e. large numbers of monosaccharides are joined together.

Classification of Polysaccharides

* Starch These are glucose polymers made up of several thousand glucose units. Starches are not water soluble. Polysaccharides may act as food stores in plants in the form of starch, or food stores in humans and other animals in the form of glycogen. Polysaccharides also have structural roles in the plant cell wall in the form of cellulose or pectin, and the tough outer skeleton of insects in the form of chitin.
* Glycogen Glycogen is found only in animals, as the equivalent of CHO reserves in plants (i.e. starch). Like Amylopectin, it has a branched chain structure of glucose units. It is soluble in water and gets converted to glucose when necessary and used by the body for energy provision. A polysaccharide that humans and animals store in the liver and muscles.
* Cellulose This is another polysaccharide which consists of a large chain of glucose units. It is similar to starch but the glucose units are linked differently. Humans do not possess enzymes capable of breaking the linkage type and are therefore unable to digest and use cellulose as a food. However cellulose is still important for providing fibre as roughage in the diet. Dietary fibre is necessary for the efficient passage of food through the gastro-intestinal tract and regular empting of the bowels. Cellulose acts as the structure material plants, found especially in the skin and fibrous parts of fruits and vegetables, and bran of cereals.
* **Chitin**  is the main component of fungi cell walls, the exoskeletons (hard outer shell/skin) of arthropods, such as [crabs](http://www.medicalnewstoday.com/articles/173681.php%22%20%5Co%20%22What%20are%20crabs%20%28pubic%20lice%29? What causes crabs?), lobsters, ants, beetles, and butterflies. Chitin is also the main component of the beaks of squid and octopuses. Chitin is useful for several industrial and medical purposes. a polysaccharide, is one of the most abundant natural materials in the world. Microorganisms, such as bacteria and fungi secrete chitinases, which over time can break down chitin. These microorganisms also have receptors to the simple sugars that result from this breakdown (decomposition). The bacteria and fungi convert the decomposed chitin into simple sugars and ammonia.
* Pectin - Pectin is a complex mixture of polysaccharides found in many fruits and root vegetables, especially apples and peels of citrus. Its main important is as a gelling agent especially in jam making. Addition of an acid e.g. lemon juice increases the gelling effecting of pectin. This is especially useful in jams made from fruits with low pectin content e.g. strawberries. In some instances the presence of pectin may be undesirable for example, fruit juice and wines where it produces an unacceptable haze.

**Function of carbohydrates**

* Chief most provider of energy
* Protein sparer

### **Dietary sources of carbohydrates**

* Carbohydrate can be derived from many food sources. These are presented here as categories:
* Cereals and cereal foods: All cereal contains a high percentage of starch: wheat, rice, maize, oats, rye, sorghum, millet and barley. Carbohydrates can also be obtained from foods made from cereals e.g. bread, cakes, pastry, pasta, breakfast cereals.
* Refined sugar: Sugar is eaten in large quantities, both in form of household sugar and in manufactured food products e.g. biscuits, sweets, chocolates, ice creams, jams, cakes, soft drinks. Glucose is prepared commercially from starch. It is found in some fruits, notably grapes, pineapples, oranges, apples, mangoes etc.
* Vegetables: Some vegetable contain starch and sugar in varying amounts. The most important vegetables supplier of CHO in the diet is the Irish potato. Pulse vegetables (beans, lentils, peas) also contain significant amounts of CHO. Root and green leafy vegetables contain smaller quantities.
* Fruits: Some fruits contain large amounts of starch. As the fruit ripens the starch is converted into sugar. Most fruits contain between 5 – 10% sugars, with sweet fruits containing the most. Bananas are the only fruit which contain starch as well as sugar when ripe. Fructose is found in honey and fruits. It is sometimes called fruit sugar.
* Milk: Milk contains the sugar lactose. Foods such as cheese contain trace amounts of sugar. Some foods contain more carbohydrates than others.

Carbohydrates provide the body with glucose, which is converted to energy used to support bodily functions and physical activity. But carbohydrate quality is important; some types of carbohydrate-rich foods are better than others:

* The healthiest sources of carbohydrates: unprocessed or minimally processed whole grains, vegetables, fruits and beans promote good health by delivering vitamins, minerals, fiber, and a host of important phytonutrients.
* Unhealthier sources of carbohydrates include white bread, pastries, sodas, and other highly processed or refined foods.  These items contain easily digested carbohydrates that may contribute to weight gain, interfere with weight loss, and promote diabetes and heart disease.

The [Healthy Eating Plate](http://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/%22%20%5Ct%20%22_blank) recommends filling most of our plate with healthy carbohydrates, vegetables (except potatoes) and fruits taking up about half of our plate, and [whole grains](http://www.hsph.harvard.edu/nutritionsource/whole-grains/%22%20%5Ct%20%22_blank) filling up about one fourth of the plate.

Daily Requirements

Lack of Carbohydrates (CHO) in the diet results in insufficient glucose being available for energy production, or resulting in fat being used to a greater extent than normal. During fat metabolism substances known as ketones are produced. In the absence of sufficient CHOs these are produced at a rate exceeding their disposal, therefore accumulating in the body giving rise to a toxic state known as ketosis.

The primary function of protein is to build body tissue. However, if lack of CHO and fat occurs, protein will be diverted from this process and used instead to give energy. Lack of CHO can thus cause depletion of body tissue as in starvation or during illness where there is inability to take food. For maximum protein sparing action, CHO and protein should be taken together as the same meal.

A lack of CHO in the diet is unusual. Under conditions in which energy requirement is increased, however, as in febrile stated and over activity of a thyroid gland, the usual intake may be insufficient to meet the unusual demand and a state of relative CHO lack occurs. In diabetes mellitus also the inability of the body cells to utilize glucose produces a lack of CHO at cell level.

### Excess CHO

An excessive intake of CHO usually implies a high intake of sugar intake, and when it boldly energy requirements, leading to conversion of excess CHO into fat, which is stored giving rise to obesity, if taken over a long period of time. Diets higher in sugar and in refined food cereals foods such as white bread are correspondingly low in fiber. Fiber absorbs large amounts of water in the large intestines and its bulks increases by as much as 20 – 30 times. This is important because it makes the contents of the bowels soft and bulky, making stools ease to pass thus preventing constipation. It is important to note that not all carbohydrates are utilized by the body. These include dietary fiber.

Activity

1. List three examples each of monosaccharide, disaccharide and polysaccharide.
2. State one function of glucose, lactose and glycogen in animals and of fructose, sucrose and cellulose in plants.
3. Outline the role of condensation and hydrolysis in the relationship between monosaccharide, disaccharide and polysaccharide.

## PROTEINS

The importance of protein requirement lies in the fact that everybody’s cell is partly composed of proteins. Protein cells are subject to continuous wear and replacement, whereas fat and glucose can be derived from proteins when need be, body proteins are inevitably dependent on protein from food for their formation and maintenance.

### Definition

The word “protein” is derived from the Greek word meaning ‘holding the first place’. Proteins literally hold the first place in the architecture and machinery of all living things. Without proteins no life could exist. Plants are able to synthesize protein from inorganic material. Carbon dioxide from the air and water from the soil provide C, H and O necessary for protein synthesis. N is obtained from soil in the form of inorganic compounds, usually nitrates (NO3 and NO2 and nitrates. Some plants – legumes are able to utilize N2 from the air with the aid of bacteria. Animals unlike plants cannot synthesize protein from inorganic compounds. Therefore protein is an essential nutrient in the diet of all animals.

Protein is built from building blocks called amino acids. Our bodies make amino acids in two different ways: Either from scratch, or by modifying others. A few amino acids (known as the *essential* amino acids) must come from food.

* Animal sources of protein tend to deliver all the amino acids we need.
* Other protein sources, such as fruits, vegetables, grains, nuts and seeds, lack one or more essential amino acids.
* Vegetarians need to be aware of this. People who don’t eat meat, fish, poultry, eggs, or dairy products need to eat a variety of protein-containing foods each day in order to get all the amino acids needed to make new protein.

## Amino acids

Amino acids are the building blocks (monomers) of proteins. Twenty different amino acids are used to make the body's proteins. Of these nine are called essential (meaning they can only be obtained from the food we eat) and eleven are non-essential (they may be synthesised in the body though they are usually obtained from food).

Essential amino acids and protein quality

The protein in food gets digested into amino acids in the body. The human body requires AAs for making specific proteins required by its many specialized tissue. The body can make some AAs by converting one to another. This occurs in the liver by a process known as transamination. Those AAs which the body is either unable to make in sufficient quantities are called essential AAs. There are 20 AAs found in protein. Eight (8) of these AAs are essential; therefore they must be supplied in the diet of all people since they cannot be synthesized in the body. One additional AA, Histidine, must be supplied in the diets of growing children. The non-essential AA can be synthesized in the body by converting one AA into another within body cells. The table below shows Essential and Non Essential Amino Acids.

|  |  |  |  |
| --- | --- | --- | --- |
| Essential amino acids/Indispensible amino acids | Essential amino acids | Non-essential amino acids/ dispensible amino acids | Non-essential amino acids |
| Leucine | Threonine  | Arginine  | Glycine  |
| Isoleucine  | Tryptophan  | Alanine  | Ornithine  |
| Lysine  | Valine | Aspargine | Proline |
| Methionine\* | Histidine | Aspartic acid | Serine  |
| Phenylalanine  |  | Cysteine\* | Tyrosine  |
|  |  | Glutamic acid |  |

NB: \*Sulphur containing AAs

* **THE HIGH BIOLOGICAL VALUE OF PROTEINS**

Some food sources of proteins are said to be of high biological value, if they are able to supply all the required essential amino acids required by the body. They can also be said as of first class or complete proteins, as they provide the body with the required number of essential amino acid e.g. children require 9 while adults 8.

* The food sources of HBV Protein include meats both red and white meat, fishes, edible insects, animal products milk, eggs and soya bean.
* **LOW BIOLOGICAL VALUE PROTENS**

Those food which will not be able to provide the body with all the required numbers of essential A/A but lack one or two are said to be of low biological value proteins, sometime called incomplete or second class proteins as they do not provide the body with the required no of protein. However when mixed together e.g. bean on toast , the biological value is increased. The food source of LBV proteins include vegetable proteins apart from soya, nuts, wheat, rice and gelatin ( animal protein which provides LBV protein).

* **IMPORTANCE OF PROTEIN IN THE DIET**
1. Require for repair and maintains of the damaged cells.
2. Second provider of energy if other sources of energy are lacking

### Daily requirements

Protein requirement of an individual depends on the growth rate and body weight. An adult requires approximately 1g of protein for every kilogram body weight. Recommendations for adult protein requirement vary between 42 and 84g per day, represents 10% of recommended energy intake. This takes into account minimum protein requirement. However, recommended intakes are higher than the minimum in order to allow for a palatable diet and also consider other important nutrients such as B complex vitamins which are found in association with protein in foods. The figures should therefore be used as guide in planning and assessment of diets and should not be applied to protein requirements of individuals.

During periods of growth proportionately more protein is required e.g. for a child aged 5 – 6 years approximately 2g of protein per Kg body weight needed. During pregnancy and lactation women need more protein in their diet, since they must satisfy protein requirement of the baby as well as their own. As a result of illness or an operation, the body uses considerable quantities of protein e.g. as a result of a femur (thigh bone) fracture the body losses about 500g proteins. Therefore during convalescences, protein content of the diet should be increased to 14% of total energy intake. It is advisable that some proteins be derived from foods of animal origin – milk, eggs, cheese, fish and meat- that are best able to supply essential AAs. It should also be remembered that the value of these foods is partly determined by relatively high contribution they make towards intake of other essential nutrients.

### Deficiecy diseases of Protein

### Protein Energy Malnutrition

Protein energy malnutrition (PEM) is the general term used to describe the spectrum of illness caused by an inadequate diet, deficient in protein and often in energy too. There are two extreme forms, *kwashiorkor* due to a dietary deficiency of protein and *marasmus* due to dietary deficiencies of both protein and energy. These two extremes were discussed in unit three. In practice the clinical picture is usually mixed and often complicated by other specific vitamin and mineral deficiencies, for example, iron and vitamin

* Retard growth in children

## FATS AND OILS

### Definition

Fats are actually a subject of the class of nutrients known as lipids, but the term fat is

often used to refer to all lipids. The lipid family includes (fats and oils), phospholipids and sterols; all important in nutrition.

Classification

Saturated fats All bonds in the fatty acid moiety are single, e.g. palmitic and stearic acid, which are in lard and suet. The term saturated indicates that the maximum possible number of hydrogen atoms are bonded to each carbon in the molecule.

Unsaturated fats

The term unsaturated indicates that fewer than the maximum possible number of hydrogen atoms are bonded to each carbon in the molecule. The number of double bonds is indicated by the generic name—monounsaturated for molecules with one double bond or polyunsaturated for molecules with two or more double bonds..

There two types:

* Monounsaturated fats

These contain 1 double bond e.g. oleic acid that is found in many fats particularly olive oil. The point of unsaturation makes it vulnerable to react with other factors that may be present. The degree of un-saturation confers fat with liquidity. The more unsaturated oil is, the more it is liquid. This is shown in polyunsaturated vegetable oils. Unsaturated fatty acids have one or more carbon-carbon double bonds.

* Polyunsaturated Fats

These contain more than one double bond e.g. a-linoleic acid (A) found in vegetable seed oils such as soya and corn oils or linoleic acid (B). Like in the monounsaturated structure one hydrogen atom is misses from the affected carbon atoms. What is the importance of these double bonds, you may ask? This question is of paramount importance to the science of oils. Firstly the degree of un-saturation renders oil to oxidative rancidity (the oil becoming bad or spoilt). To stabilize the oil, it is taken through the hydrogenation process used in the fat industry.

Fatty acids containing more than one carbon-carbon double bond ([polyunsaturated fatty acids](http://www.britannica.com/EBchecked/topic/469208/polyunsaturated-fatty-acid)) are found in relatively minor amounts. Animals cannot synthesize two important fatty acids, linoleate and linolenate, and so must obtain them in the diet from plant sources. For this reason, these precursors are termed essential fatty acids.Trans polyunsaturated fatty acids, although not produced biosynthetically by mammals, are produced by microorganisms in the gut of ruminant animals such as cows and goats, and they are also produced synthetically by partial hydrogenation of fats and oils in the manufacture of margarine. There is evidence that ingestion of these *trans* acids can have deleterious metabolic effects.

Hydrogenation The double bonds in unsaturated fats can be converted to single bonds in the process known as hydrogenation. This process alters both the chemical structure and physical properties of fat, making it harder and raising its melting point. Margarine is produced by hydrogenation of oils such as palm oil, corn oil and soya oil. Let us look at how fats behave under different conditions in the next segment.

Properties of Fat

1. Solubility Fats and oils are insoluble in water. However in the presence of suitable substance known as emulsifying agent, it is possible to form a stable mixture of fat and water, the mixture is called emulsion. An emulsion may be fat-in-water emulsion e.g. butter. Fats and oils are soluble in organic solvents such as petrol and ethanol ether and carbon tetrachloride.
2. Plasticity: Substances which possess the property of plasticity will change their shape when pressure is applied to them but remain in their newly acquired shape when pressure is removed. A mixture of triglycerides with a large range of melting point will form a fat with a wide range plastic range. This type of a fat is better for certain purposes like creaming or spreading. A margarine which spreads easily immediately after it has been taken out of the fridge is more convenient to use than butter, which has a narrow plastic range. It is completely solid at the temperature found inside the fridge (about 4ᵒC).
3. As fats are heated, there are three temperatures at which noticeable changes take place: the melting, smoke and flash points

Spoilage of Fats and Oils

Rancidity

The term ‘’rancidity’’ is used to describe spoilage of fats and oils, which occurs due to liberation of free fatty acids. There are two reactions for rancidity

Oxidation - occurs as a result of the reaction between unsaturated triglycerides and oxygen from the air oxygen molecules join the double bond of triglycerides molecules and a variety of compounds are formed which give rise to unpleasant rancid taste. The reaction is accelerated by heat, light and traces of metals especially copper. Anti-oxidants e.g. BHT and BHA are added commercially too many fats and fatty foods to reduce oxidative rancidity.

Hydrolysis- This a chemical process in which a molecule of water is added to a substance. This addition causes both substance and water molecule to split into two parts. In such reactions, one fragment of the target molecule (or parent molecule) gains a hydrogen ion.

Rancidity can be reduced by storing fats and oils in a cool, dark place in a non-metal container and by keeping fats well wrapped.

Types of Fats

Phospholipids

Phospholipids are essential constituents of cellular membranes and intracellular organelles, notably mitochondria; furthermore, they act as intermediary metabolites for the transport and utilization of fatty acids in body tissues. They are a form of transport in making sure that fatty acids are used up in body tissues.

Sterols

The sterols are complex alcohols of high molecular weight. Cholesterol is the most important sterol of animal organ, whereas sitosterol and stigmasterol are of plant origin. Cholesterol is much discussed because of the apparent relationship between high levels of cholesterol in the blood, cardiovascular problems and arteriosclerosis. However, cholesterol is a normal constituent of animal tissue. It is found in cellular membranes and body fluids and it is the precursor of cholic acid, a biliary acid. In addition, most of these adrenal hormones and sexual hormones are derived from cholesterol. A certain number of foods contain cholesterol, notably eggs, butter, offal and shellfish. Egg yolk is very rich in cholesterol, therefore three eggs spread in a week is sufficient in our diet.In plants, cholesterol is rarely present in other than small amounts, and they perform a similar function.

|  |  |  |  |
| --- | --- | --- | --- |
| WaxesIn their most common form, wax esters consist of fatty acids esterified to long-chain alcohols with similar chain-lengths. The latter tend to be saturated or have one double bond only. Such compounds are found in animal, plant and microbial tissues and they have a variety of functions, such as acting as energy stores, waterproofing and lubrication. |  |  |  |

### **Functions of fat in Cookery**

1. Colour - butter and margarine, caratone is added to some fats to give a yellow color
2. Flavour

There are unique flavors from margarine and butter which provide unique flavors to different foods.

1. Texture

Depending on the method of preparation, flour mixtures result into various textures, e.g flaky, soft and crumbs in bread

1. Tenderness

Fat provide tenderness in baked products because of its various interference with gluten, as in the previous function.

1. Shortening power of fat

Shortening is used in cakes and pastries.

1. Oil is used in emulsification in salad dressings.

###

### Functions of Fats in the Body

1. Source of energy

 Fats are oxidized in the body to provide energy for tissue activity and for the performance of the body temperature. Fats are actually a concentrated source of energy providing 37kj/g (9Kcals); compared to 16kj/g (4Kcals) from protein. A sufficiency of energy from CHO and fat ensures that protein is available for tissue formation and repair.

1. Incorporated into body structure

Some fat enters the body cells and constitutes an essential part of their structure giving it shape.

1. Protection

The deposits of fatty tissues around the vital organs hold these organs in position and protect them from injury.

1. Insulation Subcutaneous fat prevents loss of heat from the body.
2. Satiety The presence of fat in chyme as it passes into the duodenum results in the inhibition of gastric peristalsis and acid secretion, thus delaying the emptying time of the stomach and preventing early recurrence of hunger after a meal.
3. Provision of fat soluble vitamins Dietary fat provides fat-soluble vitamins and assists their absorption from the intestine. So much said about fats and there functions! Let us now talk about where you obtain these fats from as our next focus of discussion.
4. Blood Clotting

With its closely associated metabolic fatty acid products, Linolenicacid prolong blood clotting time.

Dietary Sources

Fats are obtained from both vegetable and animal sources. Fats, which are liquid below 20oC, are called oils. Fish and vegetable fats are referred to as oils because they are liquid at room temperature.

Vegetable fats These include olive oil, palm oil, cottonseed oil, corn oil, sesame seed oil, rapeseed oil, sunflower and others.

Animal fats Animal fats include beef dripping, suet and mutton fat and lard. They also include fats of daily produce, eggs, milk and its products; cream, butter and cheese. The tissues of dark fleshed fish such as herrings, salmons and sardines are oil containing. Certain fish livers are rich in oil such as cod liver oil and halibut liver oil. Excess fats can result in heart disease although the heart can be affected by many other factors such as too much sodium, lack of exercise, smoking and high calorie foods. We have also seen that fat has its roles and functions in the body and in the diet which are very important.

## MICRO NUTRIENTS

## VITAMINS

### Definition

Vitamins are a group of complex organic compounds required in small quantities by the body for maintenance of health. They are not usually synthesized in the body, are therefore essential and must be provided in the diet. They are present in food in small amounts. They were discovered when it was observed that diets adequate in calories, essential amino acids, fats and minerals could not maintain health. There are thirteen vitamins essential for healthy growth, development, cell function and metabolism. These are Vitamins A, C, D, E, K and eight B vitamins.

The term vitamin refers to any organic dietary constituent necessary for life, health and growth. Vitamins do not supply energy. Most vitamins have important functions in the intermediary metabolism or special metabolism of various body systems involved in enzyme system. Unlike carbohydrates, proteins and fats, vitamins are not chemically similar to each other. Therefore there is no general formula for vitamins. Each vitamin has a specific chemical structure and function or set of functions. The occurrence of vitamins in food is related to its solubility; *water-soluble* and *fat-soluble.* This confers the standard for qualification.

### **Classification**

There are two main classes of Vitamins

* **Fat soluble vitamins** – vitamin A,D, E, K, these are soluble in fats
* **Water soluble vitamins** – vitamin C and vitamin B complex.

Fat-soluble This group comprises of vitamins A, D, E and K. They dissolve in fat or oil but not in water. These are poorly absorbed in the body in the absence of bile or the enzyme pancreatic lipase. Some dietary fat intake is necessary for their absorption. Vitamins A and D can be stored in the liver and therefore it is possible to excessive intake, normally in extreme cases. While it is difficult to “overdose” on them from ordinary sources, consuming mega doses of fat soluble vitamins, especially A and D, can lead to a dangerous build up in the body. Quantities for fat-soluble vitamins are measured in µg. We will start our discussion with vitamin A.

Vitamin A Vitamin A is a pale yellow solid, which dissolve in fat. There are several pro-vitamins in existence all belonging to carotenoid pigments. Carotene is the most important of vitamin A pro-vitamins. It is yellow orange found in plants. Carotene is soluble in both water and fats, meaning that only a proportion of carotene gets converted to retinol.

Functions

* 1. Retinol is essential for growth and metabolism of all body cells.
	2. It is also required for formation rhodopsin (visual purple), a complex substance formed from retinol and protein. Rhodopsin is a pigment found in the retina, a membrane at the back of the eye necessary for vision is reduced or dim light.
	3. Vitamin A is also essential for maintenance of healthy surface tissues, particularly the moist mucous membranes such as cornea at the front of the eye and lining of respiratory tract.

Dietary Sources

We will consider dietary sources based on whether it is retinol or carotene, starting with retinol.

Retinol Retinol is found in fatty animal foods. Livers are rich sources, especially fish liver oil. The most important sources of vitamin A are liver, carrots, butter, milk and margarine.

 Note: Fish liver oil is not a food but a supplement. Fish liver oil is very rich in vitamin A and D and therefore potential toxicity which means that recommended doses only, should taken.

Carotene Carotene is found in many fruits and vegetables especially carrots and dark green leafy vegetables, yellow coloured fruits (peaches, paw paws, and mangoes). Since vitamin A is obtained from foods, there is a probability that one may be tempted to take in too much. Let us talk about what would happen in the event of taking too much vitamin A.

Excess

Excess vitamin A causes hyper Vitaminosis A, characterized by anorexia, headache, hepatomegaly, irritability, scaly dermatitis, and patchy loss of hair, bone pain and hyperostosis.

Deficiency

Since retinol is stored in the body, it is possible to exist for a certain period of time on a diet containing little vitamin A. However, if this period is prolonged, signs of deficiency become apparent.

* Lack of vitamin A in children’s diet reduces the rate of growth (stunting)
* Since without vitamin A the body is unable to synthesize rhodopsin, vision in reduced light is impaired causing a condition known as *nightblindness*. If deficiency is only slight increasing intake of vitamin A reverses the condition. In extreme deficiency cases the tear glands become blocked and frontal eye membranes becomes dry and inflamed, a condition known as *xeropthalmia*. Severe and prolonged deficiency can lead to cornea ulceration causing *permanent total blindness*.
* Vitamin A deficiency affects skin health and resistance to infection is lowered due to poor condition of respiratory tract mucous lining. Vitamin A is sometimes referred to as *anti-infective* vitamin.
* The best known symptoms of deficiency are xerophthalmia (loss of differentiation of the mucuous cells of the cornea).
* Bitots spots (masses of desquamated keratin on the cornea or conjunctiva
* Vitamin A deficiency also makes the eye more vulnerable to trachoma
* Other problems include kidney stones (from desquamation of transitional epithelieum in the renal pelvis), acne (keratin plugging the follicles)

Having considered too much or inadequate vitamin A intake as undesirable, how much should be taken?

Recommended intake

The Department of Health and Social Security (DHSS) recommends a daily intake of 750µg Retinol equivalent for adults. During lactation, when the women must produce milk containing sufficient vitamin A to satisfy the needs of the baby.

Losses on cooking and storage

Both retinol and carotene are unaffected by most cooking methods but small amounts may be lost during frying. Some carotenes occur during slow drying of fruits and vegetables, but in modern quick drying losses are reduced. During storage, retinol in fat foods may be lost by oxidation of the fats. This may be prevented by use of anti-oxidants, refrigeration and exclusion of light e.g. wrapping fats in foil and storing fish liver oils in dark gall bottles. None of these losses, however, is sufficiently large to be of practical significance.

Vitamin D

Vitamin D is a white crystalline compound, soluble in oils and fats but insoluble in water. The term ‘vitamin D’ refers to not one, but several different forms of the vitamin. Two forms are important in humans: vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol). Vitamin D2 is synthesized by plants, whereas Vitamin D3 is the form synthesized in your skin in the presence of ultraviolet B (UVB) rays. Both Vitamin D2 and Vitamin D3 are biologically inactive forms of Vitamin D. Before they can become active in our bodies, they must be converted to active forms in the liver and kidneys.

Food Sources

Vitamin D is naturally found in only a few foods. These include fatty fish such as mackerel, salmon and sardines, fish liver oils and eggs. Other foods may contain vitamin D that has been added during the manufacturing process, such as some milks and infant formulas, orange juice, cereals and breads. Current patterns of eating and food supplies mean that it is almost impossible to consume enough vitamin D from our diet alone.

Vitamin D supplements may contain vitamins D2 or D3. Vitamin D2 is derived from fungus or yeast. It was first produced in the 1920’s by exposing foods to ultraviolet light. This process was then patented, and licensed to pharmaceutical companies. Vitamin D3 is made in a similar way to how it is naturally produced in the skin of humans and animals. It is usually sourced from lanolin in sheep’s wool.

Sunlight

Vitamin D is formed in the skin on exposure to sunlight. The amount formed this way varies with the latitude and amount of time the person is exposed to the sun.

Functions

* Vitamin D is necessary for growth and maintenance of bones and teeth
* It is required for absorption of calcium from intestines and for uptake of calcium and phosphorous by bones and teeth

Deficiency

* Children receiving inadequate supply of vitamin develop rickets, a condition resulting in failure to absorb calcium and softening of bones. The long bones bend under the body weight (knock knees and bowlegs)
* In adults an inadequate supply of vitamin D causes osteomalacia, a condition in which bones become soft, weak and painful. They tend to fracture easily.
* Vitamin D can be a risk factor for severe tuberculosis
* Breastfed babies without recommended supplementation of vitamin D can be vitamin D deficiency.
* Supplementing calcium with vitamin D works better than vitamin D alone.
* Unusual causes of vitamin D deficiency include malabsorption, loss of vitamin D and its binding protein in the urine and in born errors of metabolism

Excess

* An excess intake of vitamin D is harmful. Vitamin D like vitamin A is not soluble in water and any excess is stored in the body rather than excreted in urine. Massive doses give rise to deposition of calcium in soft body tissue. Hypervitaminosis D is associated with weight loss and classification of many soft tissues, and excessive vitamin D intake eventually causes renal failure.
* Excess vitamins D ingestion can also lead to hypercalcermia and kidney stone formation.

Recommended intake

It is not possible to make firm recommendations for dietary intake of vitamin D since the amount of vitamin D produced in the body by the sun’s action varies from person to person. Many people may obtain all the vitamin D they need from sunlight. It is however, certain that babies and growing children require more vitamin D than adults due to bone growth. Children, during pregnancy and lactation, adults with inadequate exposure to sunlight e.g. those who are housebound may need supplement of 10xxx daily.

Vitamin E (also known as Tocopheros)

Vitamin E is fat soluble and found in many foods including wheat germ, vegetable oil, eggs and milk. Male rats deprived of vitamin E become sterile while female rats although they conceive normally, do not give birth to live offsprings.

There is no conclusive evidence; however that vitamin E influences fertility in humans. It has been used unsuccessfully to treat women who have had repeated miscarriages. Vitamin E is a natural anti-oxidant. In vegetable oils it helps to reduce rancidity by preventing oxidation of unsaturated fatty acids. It may also play a part in protecting vitamin C against oxidation in fruits and vegetables.

Vitamin K (for Coagulation)

Vitamin K is required for calcium-binding clotting factors. It is found in green vegetables and variety of other foods. It has been shown to be essential for normal clotting of blood. A deficiency of vitamin K is rarely seen if ever because the vitamin is synthesized by bacteria present in intestines as well as being present in the normal diet. Its inadequacy can result into a deficiency in newborns and those with lipid Malabsorption. It is therefore important to give the newborn some vitamin K to prevent early brain hemorrhage. It is worth remembering, however, particularly in view of advertising campaigns for vitamin pills and supplements, that very large dose of fat-soluble vitamins are definitely toxic. Hypervitaminosis K is characterized by gastrointestinal disturbances and anemia.

Water soluble vitamins

The first thing to remember is that unlike other vitamins which can be identified individually, there is no such a thing as vitamin B. This is because it is a group, all under the B series. For this reason they are referred to as B group vitamins or vitamin B complex. These vitamins include; B1 – Thiamine, B2 – Riboflavin, B3 – Niacin, B5 - Pantothenic acid, B6- Pyridoxine, B7-Biotin, B9 - Folate or folic acid, B12 - Cobalamin

B vitamins perform a variety of important function in the body. They often work together to deliver a number of health benefits: enhance immune and nervous system function, support and increase the rate of metabolism, promote cell growth and division (including the red blood cells that help prevent anemia), maintain healthy skin and muscle tone, support the health of the heart and arteries and prevent neural tube birth defects (folic acid) to mention a few. B vitamins are also very interrelated. B2 is necessary for the activation of B6. B6 and B2 are necessary for the conversion of tryptophan to vitamin B3. B12 is necessary to convert Folic acid to its active form. B6 deficiency reduces vitamin B12 absorption. This means that each plays an intricate role that cannot be ignored. That is why B vitamins are often referred to as the Vitamin B complex. Below is a quick overview of the vitamins.

B1 (thiamine)
The minimum recommended daily amount is 1.2 mg. Food sources of thiamine: whole grains, brewer's yeast, oatmeal, brown rice, asparagus, kale, cauliflower, eggs, pork, beans and peas.
Deficiency causes beriberi, a disorder of the nervous system and the heart; it also leads to neurodegeneration, wasting and death. Poor diet, alcoholism and consumption of foods rich in anti-thiamine substances and thiaminase cause thiamine deficiency. Anti-thiamine substances are tea, coffee including decaffeinated, and betel nuts.

B2 (riboflavin)
The minimum recommended daily amount is 1.3 mg. Food sources of riboflavin: organ meats (liver, kidneys and heart), milk, yeast, cheese, oily fish, spinach, green peas, eggs, almonds.
Deficiency symptoms include red and cracked lips, mouth and tongue sores, sensitivity to bright light, burning and itching of the eyes, and dermatitis.

B3 (niacin)
The minimum recommended daily amount is 16 mg for men and 14 mg for women. Food sources of niacin: tuna, salmon, swordfish, trout, mackerel, peanuts, corn, chicken, beef, lamb, brewer's yeast, beans, whole grains. Deficiency causes pellagra (a disease of "three Ds": diarrhea, dermatitis, and dementia). Symptoms include reddish skin rash, weakness, tremors, anxiety, and confusion. Large doses in excess of 1,000 mg can cause liver damage.

B5 (pantothenic acid)
The minimum recommended daily amount is 10 mg. Food sources of pantothenic acid: yeast, liver, chicken, whole grains, avocado, raw mushrooms, trout, peanuts, lentils. Food processing can destroy pantothenic acid. Deficiency of pantothenic acid is extremely rare.

B6 (pyrodoxine)
The minimum recommended daily amount is 1.7 mg. Food sources of B6: chicken, fish, liver, kidney, pork, eggs, brewer's yeast, bananas, avocado, spinach. Food processing can destroy vitamin B6. Deficiency of B6 may play a role in heart disease, kidney stone formation, carpal tunnel syndrome and depression. Symptoms include poor appetite, dermatitis, anemia, susceptibility to infection. High doses of B6 over 300 mg/day for long periods of time can cause nerve damage.

B7 (biotin)
The minimum recommended daily amount is 30 mcg. Food sources of biotin: tomatoes, romaine lettuce, almonds, eggs, onions, cabbage, cucumber, cauliflower, milk, raspberries, strawberries, oats, and walnuts. Deficiency is rare; symptoms include hair loss, scaly skin rash (cradle cap in infants), muscle pain, high cholesterol, loss of appetite, nausea. Toxicity has not been reported even at large doses.

B9 (folate)
The minimum recommended daily amount is 400 mcg. Food sources of folate: spinach, turnip greens, lettuce, dried beans and peas, sunflower seeds, liver, fortified cereals and pastas, peanuts, avocado, asparagus. When cooking, the use of steaming or of a food steamer can help keep more folate in the cooked foods, thus helping to prevent folate deficiency. Deficiency of folate causes loss of weight and appetite, weakness, headaches, irritability. Pregnant women with folate deficiencies are at high risk of delivering babies with neural tube defects. Adequate intake of folate before getting pregnant and during the first four weeks of pregnancy (600 mcg/day) prevents this. Anemia is also a sign of folate deficiency in adults.
Toxicity is considered rare. However, one should avoid heavily fortified foods since large amounts of folic acid (synthetic form of folate added to foods and supplements) in excess of 1,000 mcg/day can mask anemia caused by vitamin B12 deficiency, thus allowing the problem to progress to the point of causing confusion, dementia and possible irreversible damage of the nervous system. In view of the above it is recommended to avoid foods fortified more than 100-200 mcg of folic acid which is 25%-50% of % Daily Value. Note that folate intake from unfortified foods (vegetables and fruits) is not a concern.

B12 (cobalamin)
The minimum recommended daily amount is 2.4 mcg. Food sources of B12: liver and organ meats, muscle meats, fish, eggs, shellfish, milk and most dairy products. Since the source of vitamin B12 is animal, vegetarians need separate B12 supplementation. Deficiency causes pernicious anemia, loss of nerve-insulating myelin, leads to elevated levels of amino acid homocysteine linked to the increased risk of heart disease. The loss of nerve-insulating myelin is referred to as a peripheral neuropathy - light to very painful tingling nonstop in the hands and feet. Toxicity symptoms when consuming 20 mcg/day have been reported to include itching, rashes and diarrhea

Choline, Para-amino benzoic acid (PABA) and Inositol

These compounds are also members of the B complex vitamins but appear to be of minor nutritional significance.

Ascorbic acid (Vitamin C)

Ascorbic acid is a white crystalline powder, very stable when dry. Moderately stable in acid conditions but unstable in alkaline solutions. It is very stable in water. It is readily oxidized and losses its activity. Heat and oxidizing enzymes in vegetables both speed up in the process. However, heat destroys the enzymes and restriction of access air prevents oxygen reaching the ascorbic acid. These factors have implications on the way food is handled including preparation methods.

In the body, vitamin C is present in small amounts in blood plasma and all tissues. It is concentrated in white blood cells, adrenal glands and to a small extent in the liver and kidneys. It’s only known metabolic role is in connective tissue formation, particularly after injuries, fractures or burns, when blood concentration and urinary excretion both fall dramatically. Various measures have found that there is a “pool” of between 1.5 – 5g of vitamin C in the body and that balance of this pool is used at the rate of 45mg daily. If intake is reduced to less than 5mg daily, daily losses fall to 5mg and when the pool has shrunk to 300mg signs of scurvy begin to appear. It must therefore take several weeks of life on a diet free of vitamin C before this limit is reached, though time taken will depend upon previous nutritional status of the individual.

Sources
Vitamin C is not as widely distributed in foods as most other vitamins. It is most entirely found in fresh fruits and vegetables but not in cereals or dried pulse vegetables. Very small amounts may be found in animal foods such as raw liver and kidneys. Raw milk contains little amounts of vitamin C and some of this is still retained after pasteurization. The amount of vitamin C in fruits and vegetables is very variable, even within the same variety. Other important sources of vitamin C in the Zambian diet include guavas, mangoes, peaches, mulberries, pawpaws and the whole array of vegetables.

Black currents are potentially very good sources of vitamin C but they are eaten in insufficient quantities to make a significant contribution to vitamin C intake. Similarly some other foods such as parsley has very content of vitamin C but represent an insignificant source.

Functions

Vitamin C is necessary for formation of all tissues in the body and in particular for formation of connective material, which separates, protects and supports the various organs. It also helps with absorption of iron from intestines.

Deficiency

An individual existing on a diet containing insufficient ascorbic acid eventually develops a condition known as scurvy, whose symptoms include bruising and spontaneous hemorrhaging under the skin, gums become black and spongy and wounds and fractures fail to heal in the normal length of time. All these symptoms are caused by failure to form connective tissue. Another feature of scurvy is anaemia, which is due to failure to absorb iron therefore inability to form red blood cells.

Recommended Intakes

Since vitamin C cannot be stored in the body, regular intake is essential. However, there are many different opinions as to the amount of vitamin C necessary to maintain health. It has been shown that 100g per day is sufficient to both cure and prevent scurvy. Following major injury, severe accident or illness, the vitamin C content of the body is reduced and recovery is aided by larger than normal intakes. There is evidence to suggest that massive doses of vitamin C, 1000mg or more may alleviate some of the symptoms of respiratory infections such as common colds. Larger doses to this magnitude can only be achieved by taking ascorbic acid tablets.

### Losses on cooking and storage

Vitamin C is the most easily destroyed of all vitamins. It is very soluble in water and therefore leaches out into washing and cooking water. It also readily oxidized. Oxidation is most rapid in alkaline conditions, at high temperature, on exposure to light and traces of metals such as zinc, iron and especially copper.

Ascorbic acid oxidase, an enzyme present in plant cells increases the oxidation rate. In intact cells the enzyme is separate from the vitamin but when fruits and vegetables are bruised, cut or chopped, the enzyme comes into contact with ascorbic acid thus destroying it. However, the enzyme is inactivated at temperatures above 60oC and is therefore destroyed during cooking. In the absence of an enzyme, oxidation can still take place but at a reduced level.

Vitamin C is easily destroyed during cooking than any other vitamin. Unlike vitamin B1 where some cooking losses is more or less inevitable, amount of vitamin C lose during preparation and cooking of fruits and vegetables depends very much on the method used. Unless care is taken losses of ascorbic acid may be very large. A little soda (bicarbonate of soda) is often added in cooking green vegetables to enhance their colour. This may increase the rate of vitamin C oxidative losses as it is very susceptible to losses. The table below shows various ways of how vitamin C is lost through various stages and how these can be prevented at household level.

Recommended Methods of Minimizing Vitamin C Losses in Vegetables and Fruits.

|  |  |  |
| --- | --- | --- |
|  | Recommendation | Reason |
| Storage | Store in a cool dark place | The rate of oxidation is increased by heat and light |
| Avoid bruising fruits and vegetables | Bruising damages the cells and releases the enzyme ascorbic oxidase. |
| Preparation | Prepare just before cooking | The enzyme is released when the cells are cut |
| Do not soak in cold water | Vitamin C is soluble in water |
| Do not cut or chop more than is necessary | The enzyme is released when the cells are cut. Very thin or fine cutting increases the surface area exposed and therefore increases the chances for oxidation and losses. |
| Tear rather than cut vegetables | Tearing causes the leaves to break around the cells and therefore enzymes are not released. |
| Avoid the use of iron (non-stainless) knifes, graters etc. | Metals increases the rates of oxidation |
| Cooking | Place in boiling water | Enzyme is destroyed by heat |
| Use minimum amounts of water and a covered pot | Vitamin C leaches out in the cooking water. The greater the volume of water the greater the losses. |
| Do not over cook | Prolonged heating increases the amount of oxidation |
| Do not add sodium bicarbonate to vegetables when cooking | Alkalis increases the rate of oxidation |
| Do not cook in copper pans | Copper increases the rate of oxidation |
| Serving | Serve immediately. Do not keep in hot plates for too long periods of time | Keeping hot for 15 minutes reduces vitamin C content by 25%. 80 – 90 is lost in 1 hour. |
|  | Avoid bruising and pureeing unless there is some other source of ascorbic acid balance the meal. | Mashing and pureeing increases the rate of oxidation |

Note: In practice especially on a large scale catering it is sometimes necessary as a matter of convenience to disregard some of these recommendations. As long as reasonable care is taken, vitamin C amount lost when green vegetables are cooked will not exceed 70%.

How much vitamin C is retained in preserved foods?

Preserved foods

There is approximately 25% loss of vitamin C during canning of fruits and vegetable but a greater loss during drying. Frozen foods retain most of their vitamin C content. They may have more vitamin C than “fresh” vegetables. Since vegetables used for freezing are within a few hours of harvest. There is a gradual loss of vitamin C, though in frozen vegetables during storage.

Activity

1. Classify vitamins based on their solubility.
2. What are the functions and dietary sources of the mentioned vitamins?
3. Are there any deficiency symptoms of vitamins? Discuss!

## MINERAL ELEMENTS

 In the body, some minerals are put together in orderly arrays in such structure as bones and teeth. Minerals are also found in food fluids influencing their properties. Whatever their role, minerals do not yield energy. Because minerals are inorganic, they are indestructible and need to be handled with the special care that vitamins require. Minerals can, however, be bound to substances that interfere with the body’s ability to absorb them. They can also be lost during food-refining processes or during cooking when they dissolve in water that is subsequently discarded.A good starting point is to ask the question “what is a mineral?” Every organism and every food leaves behind it a small quantity of ash when burnt completely. This ash is actually composed of mineral salts. The mineral elements contained within the ash are chemical elements other than carbon, hydrogen, oxygen and nitrogen, which are required by the body. Minerals are thus essential to life and are supplied to living organisms by their diet mostly in form of organic salts e.g. sodium chloride but some are present on organic compounds e.g. sulphur and phosphorous are constituents of protein.

Mineral elements have various functions in the body. Calcium, phosphorous and magnesium are constituent of bones and teeth. Some elements e.g. potassium, phosphorous and sulphur are found inside body cells (intracellular) where as others are found in the fluid surrounding cells (extra cellular) for example, sodium and chlorine. Many trace elements are concerned in the enzyme body systems. In fact mineral elements accomplish several essential functions in the body such as:

* Control of water balance
* Regulation of acid-based balance/equilibrium
* Formation of part of certain tissues (bones and teeth)
* Composition of enzymes and hormones

To make the session more understandable, it is important for us to start with the classification of minerals.

### Classification

Mineral elements account for approximately 4% of body weight, remaining 96% being water, fats, proteins and carbohydrates. Some mineral such as calcium and phosphorous are present in the body relatively large quantities where as others occur in very small quantities.

The minerals are classified into 2 groups:

Macro-elements which are required by organisms in relatively large amounts and trace or micro-elements found in minute amounts. These are reflected in the table below:

|  |
| --- |
| Macro minerals/ Major minerals |
| Mineral | Function | Sources |
| Sodium | Needed for proper fluid balance, nerve transmission, and muscle contraction | Table salt, soy sauce; large amounts in processed foods; small amounts in milk, breads, vegetables, and unprocessed meats |
| [Chloride](http://www.webmd.com/a-to-z-guides/chloride-cl) | Needed for proper fluid balance, [stomach](http://www.webmd.com/digestive-disorders/picture-of-the-stomach) acid  | Table salt, soy sauce; large amounts in processed foods; small amounts in milk, meats, breads, and vegetables |
| [Potassium](http://www.webmd.com/diet/supplement-guide-potassium) | Needed for proper fluid balance, nerve transmission, and muscle contraction | Meats, milk, fresh [fruits and vegetables](http://www.webmd.com/food-recipes/ss/slideshow-exotic-fruits), whole grains, legumes |
| [Calcium](http://www.webmd.com/drugs/2/drug-1575/calcium%2Boral/details) | Important for [healthy bones](http://www.webmd.com/osteoporosis/brittle-bone-breaks-15/rm-quiz-bones-myths-facts) and [teeth](http://www.webmd.com/oral-health/picture-of-the-teeth); helps muscles relax and contract; important in nerve functioning, [blood](http://www.webmd.com/heart/anatomy-picture-of-blood) clotting, [blood pressure](http://www.webmd.com/hypertension-high-blood-pressure/guide/diastolic-and-systolic-blood-pressure-know-your-numbers) regulation, immune system health | Milk and milk products; canned fish with bones (salmon, sardines); fortified tofu and fortified soy milk; greens (broccoli, mustard greens); legumes |
| Phosphorus | Important for [healthy bones](http://www.webmd.com/osteoporosis/video/osteoporosis-prevention-lifestyle) and [teeth](http://www.webmd.com/oral-health/rm-quiz-teeth-truth); found in every cell; part of the system that maintains acid-base balance | Meat, fish, poultry, eggs, milk, processed foods (including soda pop) |
| [Magnesium](http://www.webmd.com/diet/supplement-guide-magnesium) | Found in bones; needed for making protein, muscle contraction, nerve transmission, immune system health | Nuts and seeds; legumes; leafy, green vegetables; seafood; [chocolate](http://www.webmd.com/sex-relationships/features/chocolate-answers); artichokes; "hard" drinking water |
| Sulfur | Found in protein molecules | Occurs in foods as part of protein: meats, poultry, fish, eggs, milk, legumes, nuts |

Trace minerals (microminerals)

The body needs trace minerals in very small amounts. Note that iron is considered to be a trace mineral, although the amount needed is somewhat more than that of microminerals.

|  |
| --- |
| Trace minerals |
| Mineral | Function | Sources |
| Iron | Part of a molecule ([hemoglobin](http://www.webmd.com/diabetes/guide/glycated-hemoglobin-test-hba1c)) found in red [blood cells](http://www.webmd.com/a-to-z-guides/rm-quiz-blood-basics) that carries oxygen in the body; needed for energy [metabolism](http://www.webmd.com/fitness-exercise/guide/how-to-boost-your-metabolism) | Organ meats; red meats; fish; poultry; shellfish (especially clams); egg yolks; legumes; dried fruits; dark, leafy greens; iron-enriched breads and cereals; and fortified cereals |
| Zinc | Part of many [enzymes](http://www.webmd.com/hw-popup/enzyme); needed for making [protein](http://www.webmd.com/hw-popup/protein) and genetic material; has a function in taste perception, wound healing, normal [fetal development](http://www.webmd.com/baby/ss/slideshow-fetal-development), production of [sperm](http://www.webmd.com/infertility-and-reproduction/guide/sperm-and-semen-faq), normal growth and sexual maturation, immune system health | Meats, fish, poultry, leavened whole grains, vegetables |
| Iodine | Found in [thyroid](http://www.webmd.com/women/picture-of-the-thyroid) hormone, which helps regulate growth, development, and [metabolism](http://www.webmd.com/diet/ss/slideshow-boost-your-metabolism) | Seafood, foods grown in iodine-rich soil, iodized salt, bread, dairy products |
| [Selenium](http://www.webmd.com/vitamins-supplements/ingredientmono-1003-selenium.aspx?activeingredientid=1003&activeingredientname=selenium) | [Antioxidant](http://www.webmd.com/hw-popup/antioxidants) | Meats, seafood, grains |
| Copper | Part of many enzymes; needed for iron [metabolism](http://www.webmd.com/fitness-exercise/rm-quiz-truth-about-metabolism) | Legumes, nuts and seeds, whole grains, organ meats, drinking water |
| Manganese | Part of many enzymes | Widespread in foods, especially plant foods |
| Fluoride | Involved in formation of bones and teeth; helps prevent tooth decay | Drinking water (either fluoridated or naturally containing fluoride), fish, and most teas |
| [Chromium](http://www.webmd.com/vitamins-supplements/ingredientmono-932-chromium.aspx?activeingredientid=932&activeingredientname=chromium) | Works closely with [insulin](http://www.webmd.com/hw-popup/insulin) to regulate [blood sugar](http://www.webmd.com/diabetes/guide/blood-glucose) (glucose) levels | Unrefined foods, especially [liver](http://www.webmd.com/digestive-disorders/picture-of-the-liver), brewer's yeast, whole grains, nuts, cheeses |
| Molybdenum | Part of some enzymes | Legumes; breads and grains; leafy greens; leafy, green vegetables; milk; [liver](http://www.webmd.com/hepatitis/ss/slideshow-surprising-liver-damage) |

Other trace [nutrients](http://www.webmd.com/a-to-z-guides/tc/major-nutrients-in-food-topic-overview) known to be essential in tiny amounts include nickel, silicon, vanadium, and cobalt.

Conclusion

Trace elements deficiencies are rare because any diet that is adequate in other respects easily supplies the needed minerals. Conversely some minerals can be toxic when excess amounts are present in the body. For example:

1. Iron overload cause hemochromatosis.
2. Copper excess can cause brain damage and a disease known as Wilson’s disease.
3. Aluminum poisoning in patients with renal failure who are receiving dialysis treatment causes a rapidly progressive dementia, resembling Alzheimer’s disease.
4. Salt depression is a problem only when sodium is lost in excessive amounts in stools, sweat or urin

###  **Nutrition during pregnancy and lactation**

* An unborn child needs a healthy and well-nourished mother to grow properly. Therefore, a mother needs to gain weight during pregnancy to help nourish her growing baby. Women who do not gain enough weight often have babies that weigh too little (low birth weight). A baby weighing less than 2.5 kg has an increased chance of both physical and mental health problems. It may also suffer more from infection and malnutrition compared with babies of normal weight. The increased requirement of nutrients during pregnancy and lactation is shown in Box 3.1.

####   **Increased nutrients required during pregnancy**

* Increased requirements: energy, protein, essential fatty acids, vitamin A, vitamin C, B vitamins (B1, B2, B3, B5, B6, B12, folate), calcium, phosphorus, iron, zinc, copper and iodine.
* Women should gain at least 11 kg during pregnancy (Figure 3.1). If the mother gains less than this, the baby’s chances of survival and health declines. If a mother is overweight, she still needs to gain for her baby’s health. She should not try to lose weight while she is pregnant.



#### **Gaining weight in pregnancy**

* A pregnant mother should gain weight smoothly and steadily. If weight gain occurs suddenly, she should see a health professional.
* During the first three months, she should expect to gain a total of 1–2 kg.
* During the last six months, she needs to gain about 0.5 kg each week.
* If she has already gained 11 kg after six–seven months, she should continue to gain moderately until delivery.

The baby puts most of its weight during the last few months.

* A 29 weeks pregnant woman (that is seven months and one week) has already gained 12 kilograms of weight. What would you advise her and why?

#### **Eating during pregnancy**

Women’s nutrition during pregnancy and lactation should focus on the three micronutrients (vitamin A, iron and iodine) and extra energy intake/reduction of energy expenditure. Therefore the following are essential nutrition actions related to maternal nutrition:

* A pregnant or breastfeeding woman needs extra foods, especially those that are good sources of iron.
* Pregnant women need at least one additional meal (200 Kcal) per day during the pregnancy.
* A pregnant woman needs to cut down her energy expenditure. She should reduce her involvement in strenuous household tasks that lead to higher energy expenditure.
* Pregnant women should eat iodised salt in their diet.
* Pregnant women should take vitamin A rich foods (such as papaya, mango, tomato, carrot, and green leafy vegetable) and animal foods (such as fish and liver).
* In the malarious areas, pregnant women should sleep under an insecticide-treated bed net.
* Pregnant women during the third trimester of pregnancy should be de-wormed using mebendazole or albendazole (you will learn about the doses for this in Study Session 7 of this Module).
* Pregnant women need a well balanced diet containing mixture of foods. This should include as far as possible food from the different food groups (animal products, fruits, vegetables, cereals and legumes).

Remember, there is no need for high-priced foods! A pregnant or lactating woman can get extra foods by eating a little more of ordinary meals. She should increase the amount of nourishment at one or two meals, not every meal.

####  **Preventing anaemia in pregnancy**

Some women feel weak and tired when pregnant. They may be anaemic, which in turn means that they may have difficulty in pregnancy and childbirth. Common problems linked to the mother’s anaemia include:

* Babies will be born without three to six months iron supply
* Breastmilk may have insufficient iron.

A pregnant or breastfeeding mother should have enough iron to keep herself and her baby healthy. She should eat plenty of iron-rich foods every day such as dried beans, legumes, dark green leafy vegetables, liver, kidney and heart.

A pregnant mother should go for her first antenatal care visit at the latest by the fourth month of her pregnancy. At the clinic, check her urine for excess sugar and proteins, and her blood for malaria (if she is showing signs of infection).

### **Nutrition during lactation (breastfeeding)**

* If all babies are to be healthy and grow well, they must be fed breastmilk. When a baby sucks at the nipple, this causes the milk to come into the breast and continue to flow. Breastmilk is food produced by the mother’s body especially for the baby, and it contains all the nutrients (nourishment) a healthy baby needs.
* A lactating woman needs at least two extra meals (550 Kcal) of whatever is available at home. In addition a dose of vitamin A (200,000IU) should be given once between delivery and six weeks after delivery. This will enable the baby to get an adequate supply of vitamin A for the first six months. During the first six months the best way of feeding the baby is for the mother to breastfeed exclusively. You will learn more about this in Study Session 4 of this Module. Box 3.3 shows the nutrients required during lactation.

####  **Increased nutrients required during lactation**

Increased requirements: vitamins A, C, E, all B vitamins, and sodium (applies only to individuals under age 18).

In addition to extra meals and one high dose of vitamin A, a breastfeeding woman also needs:

* Iodised salt in her diet
* At least one litre of water per day
* Vitamin A rich foods (such as papaya, mango, tomato, carrot and green leafy vegetables) and animal foods (such as fish and liver).

### **Nutritional requirements in infancy, childhood and adolescence**

The common feature of infancy, childhood and adolescence is that all these age groups are undergoing rapid growth and development. This in turn poses a heavy demand on their nutritional requirements. Small children and infants do not have a well developed body nutrient store, and therefore are more vulnerable to infection. In addition they have a larger surface area compared to their body size. All these factors increase their basal metabolic rate (BMR), resulting in an increased requirement for nutrients.

####  Increased need for nutrients

##### Energy

While most adults require 25–30 calories per kg, a 4 kg infant requires more than 100 kilocalories per kg (430 calories/day). Infants of four to six months who weigh 6 kg require roughly 82 kilocalories per kg (490 calories/day). Energy needs remain high through the early formative years. Children of one to three years require approximately 83 kilocalories per kg (990 calories/day). Energy requirements decline thereafter and are based on weight, height, and physical activity.

As an energy source, breastmilk offers significant advantages over manufactured formula milk. Breastfeeding is associated with reduced risk for obesity, a wide range of allergies, hypertension, and type 1 diabetes. It is also linked with improved cognitive development; and with decreased incidence and severity of infections. It is also less costly than formula feeding. The list below outlines the nutrients and other constituents of breastmilk:

* Water = 87–89%
* Vitamins (particularly vitamin A)
* Fat = 3–5%
* Energy = 60–70 kcal/100 ml
* Carbohydrate (lactose) = 6.9–7.2%
* Mineral = 0.2%
* Protein = 0.8–0.9%

Higher intakes of protein and energy for growth are recommended for adolescents. For most micronutrients, recommendations are the same as for adults. Exceptions are made for certain minerals needed for bone growth (e.g. calcium and phosphorus). Evidence is clear that bone calcium accretion increases as a result of exercise rather than from increases in calcium intake. Since weight gain often begins during adolescence and young adulthood, young people must establish healthy eating and lifestyle habits that reduce the risk for chronic disease later in life.

##### Water

Infants and children need plenty of water to drink, particularly when ill, or exposed to extreme temperatures.

Total water requirements (from beverages and foods) are also higher in infants and children than for adults. Children have a larger body surface area per unit of body weight and a reduced capacity for sweating when compared with adults, and therefore are at greater risk of morbidity and mortality from dehydration. Parents may underestimate these fluid needs, especially if infants and children are experiencing fever, diarrhoea or exposure to very cold or very hot temperatures.

##### Essential fatty acids

Requirements for fatty acids or fats on a per kilogram basis are higher in infants than adults. Some fatty acids play a key role in the central nervous system. However infants and children should not ingest large amounts of foods that contain predominantly fats, so it is important to get the balance right.

#####  Increased nutrients required during infancy, childhood and adolescence

 and childhood:

* Increased requirements of energy, protein, essential fatty acids, calcium and phosphorus.

#### **School aged children**

* Need at least two to three mixed meals and some snacks each day.

#### **Children 1–5 years old**

Need breastmilk until they are at least two years old. They need at least three mixed meals and two snacks each day. They cannot eat large bulky meals. It is especially important for the meals to be clean and not to contain parasites or microorganisms that could cause diarrhoea or other infection.

#### **Babies 6-12 months**

* Need breast milk eight to ten times or more each day. They need small meals, which are not bulky, three to five times a day.

#### **Babies under 6 months old**

Need only breastmilk at least eight to ten times each day

* Lactating mothers – requires increased liquid consumption for breast feeding
* Young children – require more protein, vitamins and mineral salts than adults because they are growing rap idling
* Adults

The type of job and body size. those in very active jobs will need more energy , extra liquid and sodium chloride, while machine jobs ( sedentary jobs ) e.g. office workers , nurse, doctors etc require less energy , to avoid over weight, need not too bulky meals as they may take longer to digest. Women need a smaller amount of food than men

Adolescence

This a period of rapid growth and hormones , for adulthood are produced which may cause skin disturbance , and so require plenty of fruits or vegetables and avoid eating too many fatty foods which may aggravate these condition, the diet should provide sufficient protein for their spirit growth ( a period of quick growth ) girls will need move iron to avoid anemia which may develop during menstruation.

#### Adolescent growth spurt

Adolescents also undergo a very rapid growth during their puberty (called the pubertal growth spurt). During the pubertal growth spurt, they increase rapidly both in weight and height. Therefore, they need a nutrient intake that is proportional with their rate of growth. The growth rate is very high right after birth (infancy). Then the growth rate slows down until the age of 12–14 years. At about 15–16 years (the pubertal period) there is a sharp rise in growth rate/velocity. After that, the growth rate slows down again.

Requirements for macronutrients (proteins, carbohydrates and fats) and micronutrients are higher on a per kilogram basis during infancy and childhood than at any other developmental stage. These needs are influenced by the rapid cell division occurring during growth, which requires protein, energy and fat. Increased needs for these nutrients are reflected in daily requirements for these age groups, some of which are briefly discussed below.

* Increased requirements of energy, protein, calcium, phosphorus and zinc.

Need at least two large mixed meals and some snacks each day. They can eat bulky food. Boys need a lot of calories. Girls need plenty of iron. Pregnant adolescent girls are still growing so they need more food than pregnant women.

### **Nutritional requirements during adulthood**

* The nutritional needs in adults of 19–50 years of age differ slightly according to gender. Males require more of vitamins C, K, B1, B2 and B3, and zinc. Females require more iron, compared with males of similar age.

#### **Men**

Need at least two mixed meals every day and some snacks. They can get enough energy from few large meals and from bulky food.

#### **Women**

Need at least two mixed meals every day and some snacks. If they are pregnant or lactating they need as almost as much food as men, especially if they are also doing hard physical work. They need much more iron and folate than men especially when they are pregnant.

### **Nutritional requirements during later years**

* Elderly people – require less energy, but calcium and vitamin D, vitamin C for strong bones and teeth iron to prevent anemia fiber to prevent constipation menstruating woman or girls – require adequate supplies of iron rich food to replace blood lost during menstruating.

An elderly person requires less energy than a younger individual due to reductions in muscle mass and physical activity. Some daily requirements for elderly people differ from those of younger adults. For example, in order to reduce the risk for age related bone loss and fracture, the requirement for vitamin D is increased from 200 IU/day to 400 in individuals of 51–70 years of age and to 600 IU/day for those over 70 years of age. Suggested iron intakes reduce however from 18 mg per day in women aged 19–50 to 8 mg/day after age 50, due to better iron conservation and decreased losses in postmenopausal women compared with younger women.

Some elderly people have difficulty getting adequate nutrition because of age or disease related impairments in chewing, swallowing, digesting and absorbing nutrients. Their nutrient status may also be affected by decreased production of chemicals to digest food (digestive enzymes), changes in the cells of the bowel surface and drug–nutrient interactions. Some elderly people demonstrate selenium deficiency, a mineral important for immune function. Impaired immune function affects susceptibility to infections and tumours (malignancies). Vitamin B6 helps to boost selenium levels, so a higher intake for people aged 51–70 is recommended.

Nutritional interventions should first emphasise healthy foods, with supplements playing a secondary role. Although modest supplementary doses of micronutrients can both prevent deficiency and support immune functions, very high dose supplementation (example, high dose zinc) may have the opposite effect and result in immune-suppression. Therefore, elderly people also need special attention with regard to nutritional care.

Elderly people are especially vulnerable to nutritional problems due to age related changes in their body (impaired physiological and anatomical capacity). overleaf sets out some of the problems an older person might experience which could impact on their diet.

#### Elderly need at least two and if possible more meals each day as they may not eat much at each meal. They need fewer calories than younger people, but about the same amount of protein and other nutrients. Women who have stopped menstruating need less iron than childbearing women. Old people may need soft food.

#### **Possible nutritional issues in old age**

* Problems of procuring and preparing foods
* Psychosocial problems
* Digestion problems
* Nutrient absorption problems
* Renal changes
* Memory loss (senile dementia), which may include forgetting to eat
* Sensory changes
* Physical problems like weakness, gouty arthritis and painful joints.

#### **Specific nutrient requirements in old age**

### Nutritional requirements throughout the life cycle: conclusion

Requirements for energy and micronutrients change throughout the life cycle. Although inadequate intake of certain micronutrients is a concern, problems also come from the dietary excesses of energy, saturated fat, cholesterol and eating refined carbohydrates, all of which are contributing to obesity and chronic disease in developed countries. Below is a summary of the number of meals required at different stages in the lifecycle that might assist you in your work in your community.

A SUMMARY OF INDIVIDUAL NUTRITIONAL REQUIREMENTS

****In your 20s: Focus on calcium, folate, iron****

* Men and women continue to build bone into the mid-20s, although not as readily as when younger. Meeting daily calcium requirements is important to help bones reach their peak strength. Doing so can help protect against osteoporosis and fractures later in life.
* Men and women need 1,000 mg of calcium each day. One milk serving (e.g., 1 cup milk, 3/4 cup plain yogurt, 1 1/2 ounces hard cheese) supplies about 300 milligrams of calcium. Fortified non-dairy beverages such as soy, rice and almond milks contain 300 to 330 mg of calcium per one cup. So do calcium-fortified juices.
* Other good sources include canned salmon (3 ounces = 212 mg), legumes, firm tofu, almonds, tahini and cooked green vegetables such as spinach, collard greens, rapini and bok choy.
* Folate is vital to making and repairing DNA, the genetic material of cells. While both sexes require 400 micrograms (0.4 mg) daily, women who plan to get pregnant must pay extra attention to the B vitamin to guard against neural-tube defects, birth defects that affect the brain and spinal cord.
* Folate-packed foods include cooked spinach (1/2 c = 130 mcg), broccoli (1/2 c = 84), lentils (1/2 c = 189), black beans (1/2 c = 135) and avocado (1/2 medium-sized = 113). Women of childbearing age should also take a multivitamin that supplies 0.4 to 1 mg of folic acid (the synthetic form of folate).
* Iron supports metabolism, transfers oxygen to muscles, aids mental concentration and is used to make hormones and connective tissue. Men need 8 mg of the mineral each day while women need 18 mg to offset iron losses from menstruation.
* Oysters, red meat, enriched breakfast cereals, soybeans, lentils, chickpeas, cooked spinach, prunes and raisins are good sources.

****In your 30s: Focus on calories and magnesium****

* In the 30s, the onset of age-related muscle loss slows down our body's metabolism and calorie requirements begin to decline. If you keep your same eating pattern in your 30s (and 40s) as you did in your 20s, you'll likely gain weight. (Strength training and eating enough protein can help mitigate muscle loss.)
* For every year after 30, men require 10 fewer calories a day and women need 7 fewer. In other words, by age 40, men should be eating 100 fewer calories each day than at 30; women should cut 70 calories from their daily diet at the age of 40.
* Trim calories from refined (white) starchy foods, sweets and sugars added to beverages and foods. Continue to emphasize foods rich in calcium, folate and iron.
* Men and women should also focus on magnesium, a mineral that helps generate energy for the body, regulate blood pressure and blood sugar and maintain strong bones. At the age of 31, daily requirements increase for both men (420 mg) and women (320 mg).
* To increase your intake, reach for halibut (3 oz = 90 mg), almonds (24 nuts = 80), cooked Swiss chard (1/2 c = 80), cooked spinach (1/2 c = 78), cashews (18 nuts = 75), plain yogurt (1 c = 45) and raw wheat bran (2 tbsp = 45).

****In your 40s: Focus on antioxidants****

* While vitamin and mineral requirements remain unchanged in the 40s, both sexes should focus on making nutrient-dense food choices, not only to meet daily requirements but also to pave the way for the next few decades.Include foods high in vitamins C and E, antioxidants that fend off harmful free radicals. Free-radical damage is thought to contribute to aging and many chronic diseases.
* Excellent sources of vitamin C include red and green pepper, citrus fruit, kiwi, broccoli, Brussels sprouts, strawberries and tomato juice. Vitamin E is plentiful in wheat-germ oil, sunflower seeds, almonds, sunflower oil, hazelnuts and peanut butter.
* Other dietary antioxidants include beta-carotene (e.g., carrots, sweet potato, apricots, green vegetables) and selenium (e.g., Brazil nuts, tuna, shrimp, turkey).
* Unlike supplements, whole foods provide vitamins and minerals along with fibre and hundreds of phytochemicals, which work in concert to protect health.

****In your 50s and beyond: Focus on calcium, vitamin D, B12****

* At the age of 51, women need 1,200 mg of calcium each day to help counter the rapid bone loss that occurs at menopause. Calcium requirements don't increase for men until the age of 71, when bone loss and fracture risk rise significantly. With age, men and women have a reduced capacity to produce vitamin D through sun exposure. The official recommended dietary allowance for vitamin D increases from 600 IU (international units) to 800 IU at the age of 70. However, many experts recommend adults older than 50 supplement with 1,000 to 2,000 IU each day to maintain sufficient stores.
* Vitamin B12, needed to make red blood cells, nerves and DNA, should also be supplemented after 50; a multivitamin will do the trick. Many older adults do not produce enough hydrochloric acid in their stomach to absorb the vitamin from foods.

In order to estimate nutritional requirements of individuals or groups, we need to consider the following factors:

* Physical activity — whether a person is engaged in heavy physical activity
* The age and sex of the individual or group
* Body size and composition — what the general build is of a person or group
* Climate — whether a person or group is living in hot or cold climate
* Physiological states, such as pregnancy and lactation.

Based on these factors, nutritional requirements in the different segments of the population can be classified into four groups. These correspond to different parts of the lifespan, namely (a) pregnancy and lactation, (b) infancy and childhood (c) adolescence and adulthood, and (d) old age. You are now going to look at each of these in turn.

THE DIGESTION SYSTEM

The function of the digestive system can be broken down into six major actions:

* Move food and liquids along the digestive tract
* Lubricate the food to ease movement along the digestive tract
* Mechanically breakdown carbohydrates, fats, and proteins
* Chemically breakdown carbohydrates, fats, and proteins
* Reabsorb nutrients and water
* Eliminate waste products

Summary Table of the Digestion System

|  |
| --- |
| Table 1: Physical and Chemical Digestion |
| Organ | Function |
| Mouth | chewing of food and digestion of starch by salivary amylase |
| Esophagus | transport of food from mouth to stomach; lubricated by mucus |
| Stomach | storage of food and initial digestion of proteins + fats; production of the hormone gastrin (response to protein) that stimulates stomach's gastric glands to release gastric juice (including pepsin and HCl) |
| Small intestine | continued digestion of carbohydrates, proteins, lipids; most absorption of nutrients; production of the hormone secretin (response to HCl) that stimulates pancrease to release bicarbonate; production of the hormone CCK (response to fat) that stimulates gall bladder to release bile |
| Pancreas | production of digestive enzymes that act in small intestine; production of the hormones insulin and glucagon which regulate blood sugar; production of bicarbonate that neutralizes stomach acid in small intestine |
| Large intestine | absorption of water; production of some vitamins; storage of undigested food |

|  |
| --- |
| Table 2: Substances Involved in Digestion |
| Organ | Secretion and Function |
| Salivary glands | salivary amylase - converts starch (a polysaccharide) to maltose (a disaccharide) |
| Esophagus | mucus - helps movement of food |
| Stomach | hydrochloric acid - converts pepsinogen to pepsin and kills microbespepsinogen - when converted to pepsin, initiates digestion of proteins (long chains of amino acids) to polypeptides and peptides (shorter chains of amino acids)lipase - converts lipids (eg. triglycerides) into glycerol and fatty acidsmucus - protects stomach from pepsin and HClrenin - coagulates proteins in milk to slow movement |
| Pancreas; small intestine | pancreatic amylase - converts starch (a polysaccharide) to maltose (a disaccharide)bicarbonate - neutralizes HCl from stomachenterokinase - converts trypsinogen to trypsintrypsinogen - when converted to trypsin, converts proteins into peptideserepsin - converts peptides into amino acidslipase - converts lipids (eg. triglycerides) into glycerol and fatty acidsmaltase - convets maltose (a disaccharide) into two glucose (a monosaccharide)sucrase - convets sucrose (a disaccharide) into glucose and fructose (monosaccharides)lactase - convets lactose (a disaccharide) into glucose and galactose(monosaccharides) |
| Liver | bile - emulsifies fat (large globules into smaller ones for lipase to work) |
| Gall bladder | bile - stores concentrated bile from liver |
| Large intestine | mucus - helps movement of food |
| Rectum and anus | The last part of digestion where wastes are removed |

This unit has been a long one and you will be required to tackle several activities according to their categories of nutrients:

Activity 1: Proteins

1. Classify proteins and amino acids
2. What is the difference between essential amino acids and non-essential amino acids?
3. State the chemical composition of proteins
4. Identify dietary sources of protein
5. Discuss the role of protein in human nutrition.

Activity 2: Carbohydrates

1. Compare and contrast the symptoms of Kwashiorkor and Marasmus

Activity 3: Fats

1. Discuss the functions of fats and oils.
2. Identify the food sources of lipids
3. Describe the deficiency diseases of excess intake of fats

**Activity 4: Vitamins**

* 1. State the two main classes of vitamins and their examples
	2. Fill in and complete the table:

|  |  |  |
| --- | --- | --- |
| VITAMIN | FOOD SOURCES | DEFICIENCY DISEASES |
| Vitamin A- found in plants as carotene. Carotene form the yellow/orange pigments in plants and during digestion converted into retinalVitamin DVitamin EVitamin KB1 – Thiamine, B2 – Riboflavin, B3 – Niacin, B5 - Pantothenic acid, B6- Pyridoxine, B7-Biotin, B9 - Folate or folic acid, B12 - Cobalamin | carrots ,cabbages prunes ,apricots ,tomatoes Vitamin A is formed in animals food as retinal eg milk, cheese, eggs(yolk), butter, dry fish etc liver ,kidney ,cod halibut liver oil, | Night blindnessScurvy |

### **Unit Summary**

In this unit you have learnt about nutrients, classification of nutrients and their associated deficiency diseases, You too, have looked at the individual nutrition requirements of different groupings of people.

Review Assessment

1. Discuss and analyze any of the two macronutrients under the following headings:
2. Classification
3. Chemical composition
4. Functions
5. Sources
6. Deficiency diseases
7. Define the following terms:
8. Nutrition
9. Nutrients
10. Food
11. Histidine
12. What deficiency diseases would be caused due to lack of the following mineral elements:
13. Calcium
14. Zinc
15. Fluoride
16. Iron
17. Iodine

**4.** Classify the two main groups of mineral elements with examples of food sources and deficiency diseases on each.

UNIT 3

WATER, DIETERY FIBER AND ENERGY

Introduction

This unit introduces you to other important substances such as water, dietery fiber and energy and how they relate with the body.

##### Specific Outcomes

After studying this unit, you are expected to:

* define dietary fiber and energy
* Describe the functions associated with dietery fiber and energy
* Name sources of dietery fiber and energy
* Discuss deficiency diseases of water, dietery, fiber and energy
* Calculate individual energy requirements
* Dietary sources and functions macro and micronutrient
* Discuss the energy values of various foods
* Describe recommended energy individual requirements

Time frame

* Self study: 2 hours
* Lecture contacts: 3hours

Required Resources

* Charts on Recommended daily intakes of energy for different categories of people and Energy values of various foods
* Projector
* Laptop

WATER

About 65-70% of the human body is water. Water is continually lost through skin as sweat, urine, through lungs and kidneys (urine) and must be replaced and so at a take of about 8 glasses or 2-3 litres will be required per day.

Extra water is required during illness where there is increased sweating, vomiting and diarrhoea which causes dehydration, during breastfeeding, water is required for production of milk.

Functions of Water

Water is required for;

1. Required for a body fluids e.g digestive juices, mucus, saliva, blood, lymph, sweat and urine
2. Required for chemical reactions needed to make life (metabolic reactions).
3. Keeps
4. Some nutrients dissolve in water for proper absorption
5. Lubricates joints and membranes
6. Serves as a means of transport in the body e.g materials are carried to the cells and waste products away in the blood plasm

Sources of water

* Fruits or vegetables
* Beverages or tap water
* Some water is produced during metabolic reactions in the body

Deficiency

Lack of water leads to dehydration

DIETRY FIBRE/ROUGHAGE

After food has been digested, absorbed and metabolized, water products are removed from the body by the process of excretion. Liquid water is processed by the kidneys and excreted as urine and solid water as faeces from the large intestines.

The removal of water products is vital as they are toxic (harmful) to the body. For easy functions removal of faeces form the large intestines, by the process of peristalsis which involves regular muscular contractions of the intestinal wall dietary fibre sometimes called fibre, unavailable carbohydrates or roughage which is indigestible but serves an important role as it absorbs a lot of water and binds other foods residues to itself and make the faeces soft and bulky and pass easily out of the body in the minimum time of effort.

Sources of dietary fibre

Whole grain cereals (wheat with rice, oats, whole meal bread, brown bread, breakfast cereals)

* Skins of fruits (apples, plums)
* Vegetables especially leafy vegetables
* Celery, potato skins
* Brussels sprout
* Cabbage
* Baked beans
* Red kidney beans
* Brane
* Baked apples
* Stewed dried apricots

Deficiency

Lack of fibre will lead to

1. Constipation- faeces become very hard and move slowly and a lot of effort is required to remove them, also causes abdominal discomfort and general feeling of ill health
2. It may cause diverticular disease- caused by extra strain through constipation on the walls of intestines developing blown out muscles in the walls of the large intestines, which come as a result of trying to push small and hard faeces due to the lack of fibre and insufficient water, the muscular walls have to work hard to move them out, thisincreased pressure on the walls leads to the formation of pouches of the bowel lining called diverticular.



1. High fibre diet+ soft large faeces are removed along the intestines easily
2. Low- fibre diet small hard faeces cannot be removed easily extra effort is required
3. Blown out pouches- faeces are too small, more effort is required causing blown oout pouches developing diverticula
4. Constipation can lead to varicose veins and hanias due to increased effort is required remove hard faeces in constipation
5. Can lead to cancer of the bowel and colon, diabetes and gall stones
6. Consumption of refined foods should be avaoided e.eg white bread, white rice, white flour, white breakfast, instat potatoes, white sugar, these have no dietary fibre which will lead to the problem of constipation to overcome this problem, foods with fibre should be consumed as well as exercise as it helps the intestines to keep activity.

ENERGY

Every function and process in the body requires a source of energy and without it they would be no life and so the body’s primary nutritional need is for energy to sustain life. Energy is provided in the body cells by the oxidation of compounds containing carbon

Energy requirements

Energy is required for;

1. Required for mechanical energy for movement of muscles (voluntary)
2. Chemical energy for a chemical and metabolic reactions
3. Electrical energy for the transmission of nervous impulses
4. Het energy to maintain body temperature
5. Required for basal metabolism

Sources of energy

Supplied by the three main nutrients; proteins, fats and carbohydrates and alcohols

Measurement of energy

Energy is measured in kilocalories (Kcal) or kilojoules (kj), just as weight is measured in kilograms. The energy value of food is found by burning carefully measured quantities of food by tested in a calorimeter, the heat energy produced is measured.

A kilocalorie is defined as the amount of heat energy that is required to raise the temperature of 1 kilogram of pure water by 1⸰c.

THE ENERGY VALUE OF FOOD

Energy value will vary with different compositions of foods. Fats provide the body with more than twice as much energy as the same weight of carbohydrates or proteins e.g

* 1 grams pure protein has an energy value of 4 kcal or 17kj
* 1 gram of pure fat has an energy value of 9 kcal or 38 kj
* 1 gram of carbohydrates has a energy value of 3.75 kcal or 16kj

Energy values of various foods

|  |  |  |
| --- | --- | --- |
| Food | Kcals/25g (1oz) | Kj/25g (1oz) |
| White breadWholemeal breadWhite flourBoiled ricePlain chocolateHoneyJamSugar (white)Sugar (brown)ButterMargerineLardCheese (cream)Cheese (chedda)MilkEggDouble creamRoast beefRoast porkRoast lamCod (steamed)Cod (fried)HerringApplesBananasOrangesDried fruitBaked beansPeas (fresh)Cabbage spinachPotatoes (boiled)Potatoes (fried)Potato crispsPeanutsSweet biscuits  | 68651003515580741121122262262622321201946131109908323405413221070261452368159171158 | 28627342014765133631047047094994911009755048019355045837834797168227559242294109592197286668718664 |

ENERGY REQUIREMENTS

The amount of energy used by the body is called energy expenditure, and this varies from individual according to;

* Age
* Sex
* Occupation
* Physical activity
* State of body e.g pregnancy, illness

Age

Young children required move energy for them growth and are more active than adults

Sex

Men tend to be large than women in body size and so use more energy

Occupation and physical activities

The amount of energy people use in physical activities varies according to the occupation and recreational activities, occupation are classified according to how active they are;

1. Sedentary- office workers, clerical tasks, drivers, pilots, teachers, journalists, doctors, buyers, shop workers, these are less active and will require less energy.
2. Moderately active- light industry assembly flats, railway workers, joiners, plumbers, bus conductors, farm workers, builders
3. Very active- coal miners, steel workers doctors, forestry workers, army recruits, some farm workers, builders labours unskilled workers

State of the body

* Pregnant mothers require more energy for the growth of the body
* Lactating mothers- energy is required for the production of milk
* Illness- energy may be increased due to fever but at times may decrease due to a reduction in physical activity

Recommended daily intakes of energy for different categories of people

|  |  |  |
| --- | --- | --- |
| Children | Kcal/day | kj |
| 0 – 1yr1 – 2yrs2 – 3yrs3 – 5yrs5 – 7yrs7 – 9yrs | 80012001400160018002100 | 336050405880672075608820 |
| Adolescents |  |  |
| BoysGirls | 28002300 | 117609660 |
| Men |  |  |
| 18 – 35yrsModerately activeVery active35 – 65yrsSedentaryModerately activeVery active | 270030003600260029003600 | 1133401260015120109201218015100 |
| Women |  |  |
| 18 – 35yrsSedentaryModerately activeVery activeMost occupation | 1900220025002050 | 79809240105003610 |
| Men + Women |  |  |
| 75+yrs | 2000 | 8400 |
| Women |  |  |
| PregnantLactating | 24002700 | 1008011340 |

WEIGHT REDUCTION

In order to lose weight, energy intake should reduce from foods, so that the reserves of energy stored in body fats are utilized and weight is constantly lost. Physical activity is increased also helps reduce weight.

Weight reducing diet involves calculating days energy intake and reducing it to a level at which energy reserves will be used up.

Effects of cooking on energy value

The energy value of some foods can be increased by;

1. Addition of fats as in frying e.g a fried egg has energy value of almost double that of a boiled egg (a boiled egg yield 80kcalwhile a fried egg yields 150kcal). This is because most foods absorbs substrate amount of fats during frying especially if placed before the correct cooking temperature.
2. Addition of fats to a food e.g butter to potatoes (mashed), increases the energy value
3. Grilling foods such as chops and sausages reduces energy value as it melts away the fats
4. Use of sugar substitutes such as saccharine, through sweet but have little energy value, helps to reduce energy value of drinks, custards.
5. Foods which contain a lot of water e.g fruits and vegetables are low in energy value as water yields no energy

Activity

Ask yourself or a colleague the following questions

1. What is Food?
2. Why do people eat food?
3. Why is food important?
4. Why is it important to eat organic foods?
5. What makes organic foods different from other foods?

### **Unit Summary**

In this unit you have acquired knowledge on the various sources of food obtained from the two main groups of the animal and plant kingdom. Various groups of food sources have been further analyzed.

Review Assessment

* How does the knowledge of food sources contribute to the understanding of nutrition?
* How different is red meat from white meat?
* Distinguish oily fish from white fish
* Outline the nutritive value of the following food sources:
* Spinach
* Cauliflower
* Edible insects
* Mangoes
* Cucumbers
* Melons

Assignment

* Make a booklet with attractive pictures showing the sources of foods as per their categories.

## UNIT 4

## NUTRITION STATUS AND DEFICIENCY DISEASES IN ZAMBIA

Introduction

A lot of people are affected with deficiency diseases, especially those that lack the knowledge of nutrition and the under privileged in society. This unit introduces you nutritional disorders in Zambia and interventions being put in place.

##### Specific Outcomes

After studying this unit, you are expected to:

As you study through this unit, you are expected to:

* Explain the definition of malnutrition
* Outline other deficiency diseases in children and adults, causes, prevention and treatment
* Identify Nutrition organization that help in mitigating nutritional disorders in Zambia.
* State the statistical levels of nutritional disorders in Zambia
* Suggest some of the interventions being put in place in older to overcome some of these nutritional problems.

Time frame

* Self study: 2 hours
* Lecture contacts: 3hours

Required Resources

* Charts on various nutritional disorders
* Projector
* Laptop

WHAT IS MALNUTRITION?

Malnutrition is a broad term which refers to both under nutrition (sub nutrition) and over nutrition. Individuals are malnourished, or suffer from under nutrition if their diet does not provide them with adequate [calories](http://www.medicalnewstoday.com/articles/245588.php%22%20%5Co%20%22How%20many%20calories%20should%20I%20eat%20a%20day) and protein for maintenance and growth, or they cannot fully utilize the food they eat due to illness. People are also malnourished, or suffer from over nutrition if they consume too many calories. Malnutrition can also be defined as the insufficient, excessive or imbalanced consumption of nutrients.

Malnutrition further means bad feeding (poor feeding). This usually means that the person does not get a balanced diet. Many people in Zambia or Africa are sick because they do not get a balanced diet. They do not get enough food from each of the three food group every day. Everybody needs to eat a balanced diet everyday because malnutrition has no age at all.

The food we eat contains various nutrients. A nutrient is something the body uses in order to grow, to repair tissues and to provide energy. Malnutrion under nutrition, results from little food and probably a shortage of many nutrients over a long period of time. Many people in the world are hungry and some are starving.

 Some people may say that they are never really hungry for a very long time and therefore cannot suffer from malnutrition, this is not true. There can be malnutrition without hunger, a person may feel full after eating a large amount of maize meal (Nshima), cassava, but if they eat this foods day after day with very little else added, they will begin to show some signs of malnutrition. Better food may result in a healthier body and mind, in more energy and in more positive outlook and in better brain development. The cause of small illness has been found to be a severe shortage of one nutrient over a long time. While certain diseases are related to lack of a specific nutrient, in many cases of malnutrition more than one nutrient is in short supply.

STATUS OF MALNUTRITION IN ZAMBIA AND GLOBALLY

 According to the World Health Organization (WHO), malnutrition is the gravest single threat to global public health. Sub nutrition occurs when an individual does not consume enough food. It may exist if the person has a poor diet that gives them the wrong balance of basic food groups. Obese people, who consume more calories than they need, may suffer from the sub nutrition aspect of malnutrition if their diet lacks the nutrients their body needs for good health. Poor diet may lead to a [vitamin](http://www.medicalnewstoday.com/articles/195878.php%22%20%5Co%20%22What%20are%20vitamins? What vitamins do I need?) mineral deficiency, among other essential substances, sometimes resulting in [scurvy](http://www.medicalnewstoday.com/articles/155758.php%22%20%5Co%20%22What%20is%20scurvy? What causes scurvy?) - a condition where an individual has a vitamin C (ascorbic acid) deficiency.

[According to the National Health Service (NHS), UK](http://www.nhs.uk/conditions/Malnutrition/Pages/Introduction.aspx%22%20%5Ct%20%22_blank), it is estimated that around three million people are affected by malnutrition (sub nutrition).According to the Food and Agriculture Organization (FAO), the number of people globally who were malnourished stood at 923 million in 2007, an increase of over 80 million since the 1990-92 base period. The World Health Organization (WHO) says that malnutrition is by far the largest contributor to child mortality globally, currently present in 45 percent of all cases. Underweight births and inter-uterine growth restrictions are responsible for about 2.2 million child deaths annually in the world. Deficiencies in vitamin A or zinc cause 1 million deaths each year.

WHO adds that malnutrition during childhood usually results in worse health and lower educational achievements during adulthood? Malnourished children tend to become adults who have smaller babies. While malnutrition used to be seen as something which complicated such diseases as [measles](http://www.medicalnewstoday.com/articles/37135.php%22%20%5Co%20%22What%20is%20measles? What are the symptoms of measles?), [pneumonia](http://www.medicalnewstoday.com/articles/151632.php%22%20%5Co%20%22What%20is%20pneumonia? What causes pneumonia?) and [diarrhea](http://www.medicalnewstoday.com/articles/158634.php%22%20%5Co%20%22What%20is%20diarrhea? What causes diarrhea?), it often works the other way round - malnutrition can cause diseases to occur. Globally, as well as in developed, industrialized countries,

 GROUPS OF PEOPLE AT HIGHEST RISK OF MALNUTRITION:

1. Elderly people, especially those who are hospitalized or in long-term institutional care
2. Individuals who are socially isolated
3. People on low incomes (poor people)
4. People with chronic eating disorders, such as [bulimia](http://www.medicalnewstoday.com/articles/105102.php%22%20%5Co%20%22What%20is%20bulimia%20nervosa) or [anorexia](http://www.medicalnewstoday.com/articles/267432.php%22%20%5Co%20%22What%20is%20anorexia%20nervosa) nervosa
5. People convalescing after a serious illness or condition.

### **FACTORS THAT CAN CAUSE MALNUTRITION**

Malnutrition, the result of a lack of essential nutrients, resulting in poorer health, may be caused by a number of conditions or circumstances. In many developing countries long-term (chronic) malnutrition is widespread - simply because people do not have enough food to eat.

* Poor diet - if a person does not eat enough food, or if what they eat does not provide them with the nutrients they require for good health, they suffer from malnutrition. Poor diet may be caused by one of several different factors. If the patient develops [dysphagia](http://www.medicalnewstoday.com/articles/177473.php%22%20%5Co%20%22What%20is%20dysphagia? What causes dysphagia?)(swallowing difficulties) because of an illness, or when recovering from an illness, they may not be able to consume enough of the right nutrients.
* Mental health problems - some patients with [mental health](http://www.medicalnewstoday.com/articles/154543.php%22%20%5Co%20%22What%20is%20mental%20health? What is mental disorder?) conditions, such as depression, may develop eating habits which lead to malnutrition. Patients with anorexia nervosa or bulimia may develop malnutrition because they are ingesting too little food.
* Mobility problems - people with mobility problems may suffer from malnutrition simply because they either cannot get out enough to buy foods, or find preparing them too arduous.
* Digestive disorders and stomach conditions - some people may eat properly, but their bodies cannot absorb the nutrients they need for good health. Examples include patients with [Crohn's disease](http://www.medicalnewstoday.com/articles/151620.php%22%20%5Co%20%22What%20is%20Crohn%27s%20disease? What causes Crohn's disease?)or ulcerative colitis. Such patients may need to have part of the small intestine removed (ileostomy). Individuals who suffer from Celiac disease have a genetic disorder that makes them intolerant to gluten. Patients with Celiac disease have a higher risk of damage to the lining of their intestines, resulting in poorer food absorption. Patients who experience serious bouts of diarrhea and/or vomiting may lose vital nutrients and are at higher risk of suffering from malnutrition.
* Alcoholism - this is a chronic (long-term) disease. Individuals who suffer from [alcoholism](http://www.medicalnewstoday.com/articles/157163.php%22%20%5Co%20%22What%20is%20an%20alcoholic? What is alcoholism?)can develop gastritis, or pancreas damage. These problems also seriously undermine the body's ability to digest food, absorb certain vitamins, and produce hormones which regulate metabolism. Alcohol contains calories, reducing the patient's feeling of hunger, so he/she consequently may not eat enough proper food to supply the body with essential nutrients.
* Food shortages - in the poorer developing nations food shortages are mainly caused by a lack of technology needed for higher yields found in modern agriculture, such as nitrogen fertilizers, pesticides and irrigation. Food shortages are a significant cause of malnutrition in many parts of the world.
* Food prices and food distribution - it is ironic that approximately 80% of malnourished children live in developing nations that actually produce food surpluses (Food and Agriculture Organization). Some leading economists say that famine is closely linked to high food prices and problems with food distribution.
* Lack of breastfeeding - experts say that lack of breastfeeding, especially in the developing world, leads to malnutrition in infants and children. In some parts of the world mothers still believe that bottle feeding is better for the child. Another reason for lack of breastfeeding, mainly in the developing world, is that mothers abandon it because they do not know how to get their baby to latch on properly, or suffer pain and discomfort.

### **SIGNS AND SYMPTOMS OF MALNUTRITION**

A symptom is something the patient feels and reports, while a sign is something other people, such as the doctor detect. For example, pain may be a symptom while a rash may be a sign.

Signs and symptoms of malnutrition include:

* Not being as capable at performing usual tasks
* Being less physically active, not being able to walk as far or as quickly as before
* Changes in mood, such as becoming [depressed](http://www.webmd.boots.com/depression/ss/slideshow-depression-overview) and lethargic
* [Loss of appetite](http://www.webmd.boots.com/a-to-z-guides/loss-of-appetite) and not being interested in food and drinks
* Poor concentration, for example, the person may need more time to understand questions and reply to them
* Breathing difficulties, a higher risk of respiratory failure
* The total number of some types of white blood cells falls; consequently, the immune system is weakened, increasing the risk of infections.
* Higher susceptibility to feeling cold
* Longer recover times from infections
* Longer recovery from illnesses
* Irritability.

In more severe cases:

* Skin may become thin, dry, inelastic, pale, and cold
* Eventually, as fat in the face is lost, the cheeks look hollow and the eyes sunken
* Hair becomes dry and sparse, falling out easily
* Sometimes, severe malnutrition may lead to unresponsiveness (stupor)
* If calorie deficiency continues for long enough, there may be heart, liver and respiratory failure
* Total starvation is said to be fatal within 8 to 12 weeks (no calorie consumption at all).

MALNUTRITION IN CHILDREN

Malnutrition today is the most widespread and serious problem affecting young children, combined with infections, it is the major cause of death of millions and it is responsible for the retarded growth and development of even greater numbers. Malnutrition is more than a medical problem, it is related to conditions of families and women, it is has social, economic and political roots, and it is closely associated with poverty. Between 18 and 30 months of age, malnutrition is more common during this transition period than in the first four to six months, largely because of the following reasons:

* Families may not be aware of the special needs of the child
* May not know how to prepare weaning foods from the foods that are available locally or
* May be too poor and cannot afford to buy nutritious foods due to higher prices of foods rich in nutrients
* In many places, traditional child feeding habits that were reasonably satisfactory cannot any longer be followed for reasons such as urbanization, new patterns of family structure, and changes in the patterns of women’s work.
* Most text books of nutrition and most statements about world nutrition problems indicate that the fundamental causes of malnutrition are firstly an insufficient supply of the necessary foods, and secondly, distribution of food that is available. Although these two factors are of considerable importance, thirdly, ignorance, Ignorance is the most important fundamental cause of malnutrition in our Africa.

IGNORANCE

One cannot blame people for being ignorance; it is not usually there fault. This word is not therefore rude or insulting. Nobody blamed vascodagama during the first sea voyage around Africa from Europe to India. 180 of his crew died of scurvy. They died because they were ignorant of the fact that vitamin C in fresh food prevented scurvy. These people died of scurvy because of ignorance, just as dozens of children are today dying in villages all over Africa because their mothers do not know what foods are necessary to prevent their illness. They are ignorant about this.

Among Africa and other people, there is a very widespread lack of understanding of the function of food. Most people, believe that, a person who is never hungry cannot suffer from a physical disease because of lack of something in the diet. Because malnutrition is today the most serious problem in Africa and other developing areas, it has two clinical forms which are kwashiorkor and marasmas. In the former, the main deficiency of one protein, in the latter, calories.

 It is also known that there are many children who are deficient in protein and calories, who suffer growth failure, and who are candidates for this disease symptoms, but who show know obvious warning symptoms or signs. It has been agreed that kwashiorkor usually results from consuming food deficient in protein related to calories and that marasmas is the consequence of insufficient food.

Malnutrition is especially common in small children from one to three years. This is because they need a great deal of the body building foods to grow. They are too slow to feed themselves as quickly the older children, so that they should not get a share of a balanced diet. Always put the food of the small child on a special place so as to ensure that the child eats all by him/her self. Children who are severely malnourished typically experience slow behavioral development, even mental retardation may occur. Even when treated, under nutrition may have long-term effects in children, with impairments in mental function and digestive problems persisting - in some cases for the rest of their lives. Adults whose severe undernourishment started during adulthood usually make a full recovery when treated.

THE TWO COMMON DEFICIENCY DISEASES IN CHILDREN

KWASHIORKOR

This is a disease of infants which affects children from 6 months to 5years of age. This is an African word that comes from Ghana. It means the “illness of the displaced child”. displaced means that a child has been taken away from his/her mothers breast because she has become pregnant again.

 A child with kwashiorkor does not usually look thin. He may have plenty of fat underneath his skin which makes his body look round and his cheeks look fat. His legs and hands may look too fat because they are swollen with water (oedema) and if you press on the leg of a child with kwashiorkor, your finger may leave a hole or dent behind it. A child may look fat, but underneath he is thin because his muscles have gotten thin and weak. His stomach may also become weak and loose. If you look at his shoulders and the tops of his upper arms, you can see that they are thin.

In the severe form of protein calorie malnutrition known as kwashiokor, the diet is therefore nearly always mainly carbohydrates. The immediate cause for stopping breast feeding is frequently the discovery by the mother that she is pregnant again. She often believes that her milk will now poison the child, who therefore is taken away from the breast. The young child may then be put on a diet of whatever is the staple food of the family. This may be maize, cassava, banana, millet, rice or sometimes wheat.

Causes of kwashiorkor

The main cause is a very sudden change from breast milk to semi-solid of solid foods consisting almost of entirely on carbohydrates. A diet largely of carbohydrates will not provide the material needed for the growth of the child. For a time, the child may appear to be all right, and symptoms of kwashiorkor rapidly appear.

When a child is living on a minimum supply of protein,

* The onset of fever will use the small protein stores in the body. Infections, particularly those accompanied by fever (malaria) are often followed by kwashiorkor.
* Diarrhea will prevent the absorption of the already small intake of protein.
* The child may lose its appetite either because it is ill, or because it is unhappy and feels neglected by its mother. The sudden divorce from this intimacy is a severe psychological blow which may cause the child to lose his appetite, and therefore be a factor in causing kwashiorkor.
* When a child is ill the mother sometimes thinks that the food is bad for it and will only give it any food made from starches and water.
* If the diet is barely adequate,the onset of eye and ear infections ,or polliomylitis may cause a sudden decline.

SYMPTOMS OR SIGNS OF KWASHIOKOR

* Growth failure always occur. If the child is precise age is known he will be found to have change .the weight and height are low for the age .these signs may not be obvious owing to odema (edema) and to lack of knowledge of the child age.
* Wasting of muscle is also typical and many may not be evident because of oedema.
* oedema cause swelling owing to the fluid in the tissues and is always present. It usually starts with a slight swelling of the feet and often spreads up the legs seen in the picture below later.
* mental changes are not invariabl seen. The child is usually apathetic about this surroundings and irritable when being moved or disturbed. He prefers to be still in one position and is nearly always miserable, as shown in the picture.
* the hair changes. The hair of the normal African child is usually dark black, in the texture, and has a healthy shine which reflects light. In kwashiorkor, the texture often changes, the hair becoming silkier and losing its light curt. At the same time it lacks luster, is dull and lifeless, and alter in colour to a brown or reddish brown colour. Tufts can sometimes be easily and most painlessly plucked out.
* skin changes. The skin, especially of the face, may be considerable lighter in coulour than that of either parent in some cases a dermatosis develops which tends to occur first in areas of friction or of pressure, for example, the groins, behind the knees and at the elbow. Darkly pigmented patches appear, and these may peal of or desquamate, rather like old sum-baked blistered paint. This has therefore given rise to the term “flakypaint dermatosis”.Underneath these flakes are atrophic depigemented areas which may resemble a healing burn. These areas may become secondarily infected. Skin cracks leading to ulceration may also occure.
* stools are frequently loose and and contain undigested particles of food. Sometimes they are offensive, watery or bloodstained.
* Aneamia, Few cases do have some degree of aneamia. This is due to lack of protein to synthesize blood cells. It may be complicated by iron deficiency, malaria, hookworm, etc.

In kwashirkor, there is usually some subcutaneous fat, palpable. The degree of its lack gives an indication of the degree of calorie deficiency. Mouth and lip changes of vitamin B are quite commonly found.

Kwashiorkor is an extremely serious disease, and it is a frequent cause of death in young children. Many mild cases occur which are not noticed by the parents, and therefore are never diagnosed. In these, recovery occurs if the child receives more protein and adequate calories. In the severe cases with any of the above symptoms and signs, the outcome is likely to fatal unless the child is properly treated in hospital. In all cases it is believed that some damage is done to the liver in the form of fatty degeneration. Whether this has an effect on the the subsequent health of the individual os not known.

In areas where kwashiokor occurs, there will usually be ten cases of “pre-kwashiorkor” for every case of the actual disease. These are children sitting on the brink many events, such as reduction in the diet, loss of apetite peharps for psychological reasons, measles or diarrhea, will push them over. Theses children have growth failure, their muscles show some degree of wasting, and may suffer mental changes (usually disinterestedness or apathy). These children do not have oedema or dermatoses.

If the child is given the right treatment earlier enough, the improvement in the condition is very rapid. In mild cases the treatment can be given by the mother at home. The treatment is to improve the diet by the addition of good quality protein. This can be done by fresh, clean cows milk or dried skim milk powder. The powder is mixed in the sause eating with a basic food, and porridge, in soup and with mashed fruit, such as pawpaw. It should be given 3 times a day. In addition to good quality protein the child need adequate calories because if it is short of calories, then the protein foods may be drawn upon to supply energy and will not be available for their specific function of building tissues.

 Suitable foods are;-

* Milk, meat, eggs, which supply fat as well as protein.

The very rapid recovery of children fed on these foods shows that the main cause of illness is nutritional.

In addition to good food, the child needs some care and attention from the mother. In many cases of kwashiorkor, it has been observed that the mother has become absorbed with her new baby while toddler is left to fend for the tie with the mother, with the result that the child feels unwanted and unloved and loses its apetite. Several cases of kwashiorkor are hospitalized and the life of the child will depend on treatment being given immediate. Sometimes children are taken to hospital too late the child dies before the treatment can show any result. If taken in time, the show a remarkable improvement as the pictures on the other page show.

This improvement has to be maintained by a suitable diet after they reach home. If the child goes back to a largely carbohydrate diet he or she becomes ill again very quickly.

Factors which contribute to kwashiorkor

From this we can conclude that the factors which contribute to the incidence of kwashiorkor are;

1. The high protein requirement during infacy.
2. The shortage in many areas of worl of protein foods suitable for weaning.
3. Certain social customers and lack of knowledge of cause of kwashiorkor and too little knowledge about foods.
4. Infections to which children of this age are exposed these could be gastro-intestinal disturbance causing diarrhea or worms, or whooping cough measles and tuberculosis.

MARASMUS

This is another form of protein calorie malnutrition. Where as in kwashiorkor the main deficiency is one of protein, in marasmus the main deficiency is of the calories. Marasmus is only another word for “starvation”, or not having enough food of any kind to eat. Marasmus occurs most frequently in children under one year old the child is starved, either because too little food is offered or because he cannot absorb the food offered.

Marasmus may occur at any age up to 3 and half years but in contrast to kwashiorkor is more common during the first year of life. It is infact a form of starvation, and the possible underlying cause of it is numerous.

CAUSES OF MARASMUS

* The chief cause of the latter is infective diarrhea.
* The child getting neither adequate supply of breast milk nor of any alternative food suitable for it.
* Another cause may be a long illness such tuberculosis.
* A lack of knowledge of weaning and bad advice may result in little foo
* Milk often diluted with a great deal of water.
* The commonest cause is early cessation of breast feeding. This may be due to death of the mother, failure of lack lactation, separation of the mother from the child due to family trouble, working mother etc., or the mothers desire to feed her baby from the bottle rather than the breast.

 Other causes of marasmus are:

* Prematurity
* Digestive upsets (dysentery,vomiting etc), and infections diseses such as tuberculosis.
* Early cessation of beast feeding does not necessarily lead to marasmus
* Another cause of maramus is prolonged breast feeding without the introduction of other food or enough other foods. It is unusual for a mother to produce a sufficient quality of breast milk to supply all the calories and other nutrients necessary for an infant over nine months of age

 DESEASE SIGNS

* In all cases the child has failed to growth.
* Children with marasmus are always underweight and sometimes only weigh half as much as should at their age .
* In several cases the loss of flesh is obvious ,the rib are prominent,
* The face has the characteristic of a monkey appearance ,
* Arms and legs are like sticks.
* Muscle are very thin, and arms circumference, is very small indeed.
* The Head looks big because the body is very small.
* The muscle are always extremely wasted. There is a little if any subculanenious fat left.
* The skin which hangs in wrinkled, especially around the buttocks and thighs when taken between fore finger and thumb will reveal the absence of the usual layer of adipose tissues.
* most likely children with maramus are not disinterested like those with kwashiorkor, instead the deep sinken eyes have a rather wide awake appearance as show in the picture, loss of subcutaneous but bright ,wide awake eyes.
* the child usually has a good appetite. Infact like any starving being , he be reverous. He often violently suck his hand or clothes or anything else available . sometimes he is heard making surcking noises
* stools may be loose, but this is not a constant feature of the diseases diarrhea. Diarrhea of an infective nature, as mentioned earlier, nay commonly have a precipitating factore.
* anemia due to protein and other deficiencies present

An advance case of the diseases presents an unmistakable picture which thone seen is never forgotten. The infant is appallyningly thin ,the belly is contrast to the rest of the body may be protuberant ,the face is quite characteristic ,with deepset eyes, and the skin draw of the bone promineurces give it a simian.

In contrast to kwashiok , is no oedima and no flaky point dematosis. There may be pressure sores but there are usually over bony promineces ,not in the areas of frictmon. There is more frequently to change of texture ,of the diseases as such the diseases as such but is dependent on the severity pf the diarrhea.



Prevention and control

* A protein rich diet will help the patient return to health.

### **Nutritional Disorders**

Several different [nutrition](http://www.medicalnewstoday.com/articles/160774.php%22%20%5Co%20%22What%20is%20nutrition? Why is nutrition important?) disorders may develop, depending on which nutrients are lacking or consumed in excess. For the healthy growth of the individual, a nourishing, well balanced diet is required. A diet which has nutrients in the right proportion ensures proper grow th and development of both body and mind. If the nutrients are inadequate or not in the right proportion nutritional disorder may occur. For example, excess carbohydrates or fat in the diet more that required for immediate energy needs can lead to obesity. The excess is stored as increased amounts of adipose tissue and body fatness. Obesity is associated with health problems such as diabetes, hypertension and heart disease.

Activity

Discuss the following with a friend or in a group:

1. Outline other deficiency diseases in children and adults, causes, prevention and treatment
2. Identify Nutrition organization that help in mitigating nutritional disorders in Zambia.
3. What is the statistical levels of nutritional disorders in Zambia
4. State some of the interventions being put in place in order to overcome some of these nutritional disorders.

### **Unit Summary**

In this unit you have acquired knowledge on the caiuses of malnutrition, other common nutrition disorders such as diabetes and other coronary heart diseases and recommended prevention measures.

Kwashiorkor

Kwashiorkor develops during early childhood when after prolonged breast-feeding the child is weaned onto a diet based on a starchy staple food, which has low protein content. Although able to eat sufficient to satisfy his energy requirements, this quantity of food does not contain adequate protein. A child whose diet is deficient in protein is unable to synthesize sufficient new body protein. This results in retardation of growth, increased susceptibility to infection and slow recovery from injury and infection. Some physiological adaptation to a low protein intake does occur but any condition that increases protein requirement such precipitate severe kwashiorkor. Its clinical signs are growth retardation, oedema, muscle wasting, liver enlargement, skin and hair pigmentation changes.

Signs and Symptoms Kwashiorkor

* Growth is stunted
* Appetite is poor
* The eyes a bulging
* Stomach gets distended
* Skin may become dark ad start peeling
* Hair may become dull and loose, luster
* The patient becomes thin with long

Prevention/control

* Include food rich in protein, the disease can be cured with wheat, peanut ad many more as already alluded to in this unit.

Marasmus

Marasmus is a wasting away of body tissue and develops when the diet lacks sufficient energy and protein. In developing countries, it is common in infants It is sometimes referred to as childhood starvation and is most commonly caused by early replacement of mother’s milk by other foods of low protein and caloric value or incorrect bottle-feeding. The milk is over diluted and so provides an inadequate diet. Gastroenteritis is commonly caused by incorrect bottle-feeding. The milk is over diluted and so provides an adequate diet. Gastroenteritis is common and may also precipitate marasmus by increasing intestinal loses and nutritional requirements and also because it is often treated with starvation by parents. The clinical signs are muscle-wasting, loss of subcutaneous fat layer and growth retardation.

PEM also occurs in adults though it is less severe because relative protein requirement is lower. It results in small stature and low weight, high disease prevalence, a shorter life expectancy and low birth weight in babies of marasmus mothers [BMI < 18.5].

Signs and Symptoms of Marasmus

* Extreme loss of muscle and fat
* As the fats and tissue protein are used up for the production of energy, the infant develops a shriveled look
* Ribs become prominent and limbs become very thin as the fat layer beneath the skin disappears
* Retarded physical and mental growth
* Severe diarrhea and other digestive disorders
* A child with marasmus is cranky and irritable, skinny rather than swollen with edema.

Review Assessment

* Discuss the symptoms of various nutritional disorders common in Zambia

Assignment

* Visit at least three organizations that help to mitigate nutritional problems and write a report of your visit.

## UNIT 5

##  RECOMMENDED DIETARY GOALS

Introduction

This unit introduces you to the recommended dietary goals for healthy eating.

##### Specific Outcomes

After studying this unit, you are expected to:

* Identify food groups associated with nutrient content
* Name food sources according to the recommended dietary goals
* Describe the recommended intakes for healthy eating
* Suggest ways for reducing fat, salt, sugar and alcohol
* Suggest ways for increasing fiber intake.
* Draw and illustrate healthy eating guides- food pyramid/my health plate

Time frame

* Self study: 2 hours
* Lecture contacts: 3hours

Required Resources

* Chart on food groups and healthy eating pyramid/my plate
* Packets of nutritional labelling
* Projector
* Laptop

FOOD GROUPS

Food sources apart from being categorized into their groups as discussed in the first unit of this module, are further divided into food groups to make healthy diets. These food groups are classified according to the nutrients they contribute in the meal to be eaten or according to the proportions of amount of food to be eaten.

Food groups according to nutrients.

There 3 main food groups chosen according to the nutrients they contribute:

1. Energy giving foods- these provide the body with carbohydrates for energy. Most gotten from cereals, tubes.
2. Body building foods- these provide the body with proteins for growth in children and repairing of worn out tissues. Mostly obtained from animals sources thus meat and poultry, animal products such as milk and eggs and edible insects
3. Protective foods- these provide the body with vitamins for protection against diseases. Mostly obtained from fruits and vegetables.

GROUPING FOOD ACCORDING TO RECOMMENDED PROPORTIONS

Recommended dietary goals

In recent years there has been an increase in certain diseases believed to be related to the type of food we eat and the lifestyle of people. The National Advisory Committee on Nutrition Education (NACNE) drew a list of recommendations or dietary goals for people to follow in order to encourage health eating.

These dietary goals include;

1. Eat less sugar, to reduce cases of dental caries and overweight.
2. Eat less fat to lower the level of cholesterol in the blood and help to reduce the risk of heart diseases.
3. Eat more dietary fiber to help prevent the development of intestinal disorders e.g constipation.
4. Eat less salt- to prevent high blood pressure.

Drink less alcohol of not more than 4% per day to lower the risk of damage to the liver and heart, as well as lessening the social problems associated with alcohol consumption.





Some suggestions made for following dietary goals.

1. Reducing sugar consumption.
* Avoid adding sugar to drinks and choose soft drinks that have a reduced sugar content or contain sugar substitutes (artificial sweetness such as saccharin). E.g fruits into meals without more sugar to them.
* The sugar reduced products such as fruit canned in fruit juice, jams and spreads.
* Gradually cut down on the amount of sugar normally added to items such as custard meal fast cereals, cakes and biscuits etc.
* Restrict the consumption of sweets and other sugar containing snacks, so that they become a treat rather than a habit.
1. Reducing fat consumption
* Use low fat dairy products e.g yoghurt can be used a substitute for cream, cheeses (cottage)skimmed milk and semi- skimmed milk.
* Make more use of low fat spreads as a substitute for margarine and butter.
* Avoid fried foods, but grill or bake or boil instead.
* Become aware of the many foods such as sausages, cakes, biscuilts, crisps and pastries which have a high hidden fat content(invisible fat but included in ingredients).
* make more use of some of the fat reduced products e.g caned fish in brine, low fat salad divising etc.
1. reducing salt intake
* try alternatives flavours to salt e.g spices and herbs when cooking make use of salt substitute with less sodium.
* Reduce the amount of salt added to cooked items such as vegetable meals at the table.
* Cut down on salty snack food e.g roasted peanuts and crisps.
* Reduce the number and amount of foods eaten that have salt added as part of their processing e.g bacon, cheese, sausages, cooked meat, smoked fish, canned vegetables in brine etc
1. Reducing alcohol comsumption
* Became aware of the alcohol content of different types of drinks.
* Where possible dilute alcoholic drinks with fruits juices, mineral waters etc.
* Make a positive effort to limit the number and amount of alcoholic drinks taken at any time.
* Try some of the alcohol reduced beverages available now.
1. Increasing dietary fibre consumption
* Make more use of wholegrain cereal product in cooking e.g whole meal flour, instead of white whole meal bread instead of only white bread whole grain rice, whole meal pasta etc.
* Eat more fresh fruits and vegetables
* Choose breakfast cereals and snacks rich in fibre and low in sugar.

NUTRITIONAL LABELLING

Following recommended dietary goals, food manufacturers should show nutritional content of their products on the labels they use. It is by law that all manufactures show the list of nutritional content of food products as well as all the other ingredients and additives.

Activity

* Analyze and discuss with a classmate the components of the healthy eating pyramid or my healthy plate
* Collect various food packages and analyze their nutrition contents

### **Unit Summary**

In this unit you have interacted with knowledge on the recommended dietary goals and how various food in takes associated with nutritional disorders can be reduced.

Review Assessment

* Make suggestions on how the following foods can be reduced as a way of preventing the nutritional deficiency diseases:
1. Fat consumption
2. Salt in take
3. Alcohol consumption
4. Sugar in take
5. Fiber consumption

Assignment

* Make a chart on a healthy eating food pyramid to use as a teaching aid.

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