MODULE X : Nutrition

Biochemistry – Undergraduate Programme

Faculty of Medicine and Allied Sciences
Rajarata University of Sri Lanka

Broad Objectives

At the end of this course, the student is expected to know

1. digestion and absorption of food and utilization of nutrients.
2. sources of energy, energy requirements, methods of assessing energy requirements and calculation of energy requirements of a given subject.
3. protein quality, requirements, functions, indicators of protein-energy deficiency and calculation of protein requirement of a given subject.
4. vitamins, their functions, signs and symptoms associated with vitamin malnutrition and their sources and dietary requirements.
5. the macro and micro minerals in the body, their distribution, functions and their sources and dietary requirements.
6. types of dietary fiber and their contribution to health.
7. the significance and the use of anthropometric measurements in health and disease.
8. rich sources of nutrients, effects of processing of food on their bioavailability and correct methods of food preparation to reduce nutrient losses.
9. the use of food composition tables in the preparation of a balanced diet for a given subject.
10. diets to be recommended for different physiological and pathological conditions and reasons for such recommendation.
11. the correct dietary practices for all ages in health and disease and the corrective measures to be taken where malnutrition exists.

Specific Objectives

1. Digestion and Absorption

1.1 Recall the end products of digestion of carbohydrate, protein and fat.
1.2 Recall the factors that promote and interfere with the absorption of fat, fat soluble vitamins, vitamin B_{12}, iron and calcium.
1.3 Recall the mechanisms involved in the absorption of glucose, amino acids, sodium, potassium, calcium, iron, vitamin B_{12}, fat and fatty acids.
1.4 Explain the uptake and metabolism of alcohol.
1.5 Explain the advantages and disadvantages of alcohol as a beverage.
1.6 Explain food allergy in relation to cow's milk, fried food, pineapple, tuna fish ('balaya') and gluten in wheat.
1.7 Recall the objectives covered under digestion and absorption of nutrients in the gastro intestinal system (GIS).

2. Energy Requirements and Sources

2.1 General

2.1.1 Draw a diagram to show the flow of energy in the biosphere.

2.1.2 List the major physiological activities that use energy in man.
2.1.3 Recall that a major portion of maintenance energy is for maintaining the Na^+/K^+ pump
2.1.4 Define a Kilocalorie (Kcal) and a Kilojoule (KJ). Explain why KJ is more acceptable than the Kcal in representing energy requirements.

2.2 Energy Value of Foods

2.2.1 Explain the term "physiological fuel value of a food". Explain how and why this differs from the heat of combustion of food.
2.2.2 State what "Atwater factors" are. State the Atwater factors for starch, fat, protein & ethanol.
2.2.3 Explain how the energy value of foods given in "food composition tables" has been derived.
2.2.4 Calculate the energy value of (i) milk (ii) rice, from knowledge of the composition of these foods.
2.2.5 Define "respiratory quotient" (RQ).
2.2.6 State the R.Q. for (i) glucose (ii) protein (iii) fat and (iv) mixed diet
2.2.7 Explain the term "energy value of oxygen" for a food.
2.2.8 Explain how the measurement of R.Q. could be used for assessing the energy output of an individual.
2.2.9 Explain the conditions under which R.Q. is 1.0, 0.8, 0.7 and 0.85

2.3 Energy Expenditure

2.3.1 Explain "basal metabolism" and "Basal Metabolic Rate" (BMR).
2.3.2 List the standard conditions under which the BMR is measured.
2.3.3 Explain the influence of body size, composition, sex, age, pregnancy and hormones on the BMR.
2.3.4 Explain thermogenic effect of foods.
2.3.5 Explain the effect of body size, composition and physical activity on the energy expenditure of an individual.
2.3.6 Explain how BMR is altered when plasma T_3 and T_4 levels are elevated, in starvation and when the energy intake is increased.

2.4 Energy Requirements

2.4.1 List the different ways of assessing the energy requirements of (i) an individual (ii)a population.
2.4.2 Compare the advantages of dietary surveys with those of surveys of energy expenditure in assessing requirements of a population.
2.4.3 Recall that energy requirement of an individual is calculated from knowledge of the energy value of different activities performed and the duration of each activity during a 24 h period.
2.4.4 Recall that the energy requirement of an individual is now calculated in terms of his / her own BMR.
2.4.5 Recall the energy value of different physical activities of men and women in relation to the BMR.
2.4.6. Be able to calculate BMR using equations that include gender, weight, height and age
2.4.6 State what adjustments are made for variation in body size and age.
2.4.7 State how the recommended allowance for pregnancy and lactation has been computed.

2.4.8 State the recommended allowance for an infant.
2.4.9 Explain why the energy requirement of a population is taken as the mean and not as mean + 2SD.

2.5 Excess Energy

2.5.1 Explain the term Body Mass Index (BMI) and how it is used to determine obesity.
2.5.2 Recall that overweight refers to more than 20% over the ideal body weight and underweight refers to less than 10% of the ideal body weight.
2.5.3 Calculate the ideal body weight of an adult whose height & body frame are given.
2.5.4 Recall that body frame is classified into small, medium and large frame by measuring the width of the elbow.
2.5.5 Explain how T_3 and T_4 influence energy metabolism.
2.5.6 State the role of brown adipose tissue in the new born.
2.5.7 Explain the biochemical derangements that follow excess energy intake.
2.5.8 Explain why a surplus of energy intake in early childhood is a predisposing factor in development of obesity in the adult.
2.5.9 Recall that those who are slightly overweight recover faster from surgery than those who are underweight.

2.6 Sources

2.6.1 List the foods that supply most of the energy in the Sri Lankan diet.
2.6.2 State the proportion of energy derived from carbohydrate, fat and protein in an average Sri Lankan diet. Explain the necessity to include at least 10% of the dietary energy as carbohydrate.
2.6.3 State the disadvantages of obtaining a high proportion of energy requirements from sucrose.
2.6.4 State why fat forms an essential component of the diet.
2.6.5 Explain why PUFA, MUFA & SFA are included in the diet
2.6.6 Recall that the protein requirement of adults could be satisfied when protein supply 10% of dietary energy.
2.6.7 State why, in all cases where additional energy is required for work, it should be supplied by cereals and vegetable oils and as little as possible by animal food.
2.6.8 Recall that alcohol provides 7 Kcal of energy per gram.
2.6.9 State the possible effects of alcohol on the nutrient intake.
2.6.10 State the effect of (i) carbohydrate (ii) starvation (iii) a high fat diet, on the oxidation of alcohol.
2.6.11 Explain the secondary nutritional deficiencies caused by high alcohol consumption.
2.6.12 Using WHO recommendations, calculate your own energy requirement. State what changes there would be in the requirement, if you were a labourer working for 5 hours a day (i) on a tea estate in Nuwara-Eliya (ii) in a rice field in Polonnaruwa.
2.6.13 Calculate the weight of the food you would purchase for a day, if you obtain 70% of your energy requirement from (i) rice (ii) bread (iii) manioc. State the disadvantages of using manioc and maize as a staple food.

3. Proteins in Nutrition

3.1 General

3.1.1 Explain why protein is an essential dietary constituent. State why it is classified as an aliment and as a nutrient. List the functions of dietary protein.

3.1.2 Explain what is meant by (i) the dynamic state of body protein (ii) labile body protein.

3.2 Nitrogen Balance

3.2.1 Explain the meaning of the term "Nitrogen Balance". If a subject is in N equilibrium, may it be inferred that his protein intake is adequate? Give reasons.

3.2.2 Describe the design of an experiment to check whether a subject is in N balance. Under what conditions would the measurement of urinary and faecal N losses alone be adequate for estimating N output.

3.2.3 Explain the significance of a negative N balance.

3.2.4 State why there is a negative N balance after injury. State whether this negative balance can be prevented by feeding a high protein diet (i) before the injury is caused (ii) immediately after the injury. Give reasons. Explain how K^+ excretion is affected by injury.

3.2.5 State why a high energy diet should be prescribed immediately after an injury and a high energy - high protein diet during convalescence.

3.2.6 How is N balance affected by strenuous muscular exercise? Is it essential that all athletes in training should be given a high protein diet?

3.2.7 Explain the effect of energy intake on N balance.

3.2.8 Explain 'protein sparing action' by carbohydrates and fats.

3.3 Amino acid patterns

3.3.1 State why some amino acids are labelled "essential" and others "non-essential".

3.3.2 List the different functions performed by amino acids in the body. Explain how some amino acids have a sparing action on others.

3.3.3 State the effect of a deficiency of an essential amino acid.

3.3.4 State when an amino acid would be toxic to the body.

3.3.5 State the amino acids that are essential for (i) an infant (ii) an adult. State how the proportion of non-essential amino acids influence the essential amino acid requirement.

3.3.6 Explain how the essential amino acid requirement changes with age.

3.3.7 Explain what is meant by an amino acid imbalance. Explain what evidence there is to show that an imbalance of essential amino acid influences growth. State the cause of the growth depression in an imbalance.

3.3.8 Recall that pellagra among those whose staple diet is sorghum vulgara is due to an amino acid imbalance.

3.4 Nutritive Value of Proteins

3.4.1 List the commonly used biological methods for the assessment of nutritive value of proteins.

3.4.2 Define "Digestibility Coefficient" and "Net Protein Utilization" (NPU). State how these are measured. State the (i) advantages (ii) disadvantages of using NPU as an index of nutritive value.

3.4.3 Explain what is meant by the 'amino acid score' of a dietary protein. Why does this value change when the age of the person who consumes it changes?

3.4.4 Define "limiting amino acid". State how the amino acid score of a protein or of a mixture of proteins is calculated.

3.4.5 Explain how the amino acid score of dietary proteins compare with their NPUs

3.4.6 List the foods commonly eaten in Sri Lanka in descending order of the NPUs of their protein.

3.4.7 List the dietary factors that affect the nutritive value of the proteins in the diet.

3.4.8 Explain why whole egg and milk proteins are used as reference proteins.

3.5. Protein Requirement

3.5.1 Describe the "factorial" method of assessment of total N requirement of an individual.

3.5.2 State the obligatory losses of N in urine, faeces and sweat. Explain the N lost in urine on a protein free diet.

3.5.3 Explain how protein requirement is derived from N balance studies?

3.5.4 Explain what is meant by the "Safe Level of Protein Requirement".

3.5.5 State the recommended allowance of protein for (1) an adult man (11) a pregnant woman (111) a lactating woman (IV) a pre-school child. State the adjustments that have to be made in these allowances when the NPU of the dietary protein is 70.

3.5.6 Estimate the weight of rice that would have to be eaten by a one year old child if he is to derive his entire protein requirement from cereal based diet. Assume the amino acid score is 55.

3.6 Protein Homeostasis

3.6.1 Explain what is meant by protein homeostasis.

3.6.2 List the ways in which the body attempts to maintain protein homeostasis during sub-optimal protein nutrition. State what part, loss of appetite plays in this process.

3.6.3 State the effect of (I) protein deficiency (II) starvation, on the synthesis of urea and of protein in the liver and the synthesis of the protein in the muscle.
3.6.4 State what role endocrines play in protein homeostasis.
3.6.5 Explain the changes you expect to find in the liver of an animal force-fed a diet rich in carbohydrates but deficient in protein. Give reasons. State how these changes would compare with those seen in an animal kept on a low-energy diet for a long time.

3.7 Protein Energy Deficiency

3.7.1 Recall the two major types of protein energy deficiency seen in children. List the clinical signs and symptoms seen in the two types.
3.7.2 State the biochemical changes you would expect to find in the blood of a child fed a protein deficient diet
3.7.3 State the effect of protein deficiency on the physical and mental growth of children and on their learning and behaviour.
3.7.4 State why it is important to chart the weight of a pre-school child regularly.
3.7.5 Discuss the significance of (i) the creatinine/height index (ii) the urinary urea/creatinine index (iii) the hydroxyproline/creatinine index (iv) serum amino acid ratio, in the assessment of PED.

4. Vitamins

4.1 General

4.1.1 Explain the term 'vitamin' and state how it differs from an enzyme and a hormone.
4.1.2 State the contributions made by Eikjman, Hopkins, Takaki, Whistler, Cashmere, McCallum and Davis to vitaminology.
4.1.3 Explain why British sailors were referred to as 'Limeys'.
4.1.4 List the water soluble and fat soluble vitamins.

4.2 Vitamin A

4.2.1 Recall that retinol, retinal and retinoic acids are active forms of vitamin A and state their possible functions.
4.2.2 State the characteristic features of the structure of retinol, retinal and retinoic acid.
4.2.3 Recall that vitamin A can be derived from carotenes through the action of dioxygenase and that one molecule of beta-carotene gives rise to two molecules of vitamin A whilst alpha- and gamma- gives rise to only one.
4.2.4 Explain why 6 micrograms of dietary beta carotene and 12 micrograms each of alpha and gamma carotene is taken as equivalent to 1 microgram of dietary retinol.
4.2.5 Define the international unit (I.U.) of vitamin A.
4.2.6 State the factors that promote the uptake of vitamin A and provitamin A.
4.2.7 Explain how vitamin A is transported in the blood and stored in the liver.
4.2.8 Describe the site of synthesis, turnover and function of retinol binding protein.
4.2.9 Describe how avitaminosis A gives rise to nyctalopia (night blindness).

4.2.10 Describe the changes in the epithelium over the cornea and conjunctiva and explain how avitaminosis A gives rise to blindness.
4.2.11 Explain how vitamin A deficiency affects the eye, the GI tract, the skin, reproduction, bone and gene expression.
4.2.12 State the signs and symptoms associated with vitamin A deficiency and toxicity.
4.2.13 Explain how vitamin A is metabolized and excreted.
4.2.14 List foods commonly eaten, that is rich in a) vitamin A. b) provitamin A.
4.2.15 Describe the steps you would advocate to lower the incidence of vitamin A deficiency among pre-school and school children.
4.2.16 State the requirements of vitamin A.

4.3 Vitamin D

4.3.1 Recall the characteristic structural features of vitamin D.
4.3.2 Recall that 1,25 dihydroxycholecalciferol (1,25 DHCC) is the active metabolite of vitamin D_3 and explain its synthesis, starting from cholesterol in the skin.
4.3.3 State the range of the wavelength of UV light that helps in the conversion of cholesterol to vitamin D.
4.3.4 State the stimulus for the synthesis of 1,25 DHCC.
4.3.5 State the mode of action of 1,25 DHCC in the enterocyte, osteocyte, on mitosis and growth.
4.3.6 Explain the changes that take place in the bone and blood in vitamin D deficiency.
4.3.7 Explain why rickets was referred to as 'a disease of poverty and darkness'.
4.3.8 State the age groups in which a) rickets b) osteomalacia occurs.
4.3.9 Explain the difference between nutritional and renal rickets.
4.3.10 State the recommended daily allowance (RDA) for infants, children and adults.
4.3.11 State dietary sources rich in vitamin D.
4.3.12 Explain the likely effects of excessive intake of vitamin D.
4.3.13 Recall that maximum bone density is achieved at 25 years and supplementation will have an optimum effect before this age.

4.4 Vitamin E

4.4.1 Recall the characteristic structural features of tocopherols that make it function as an antioxidant.
4.4.2 List foods rich in vitamin E and explain the advantage of having high levels of vitamin E in natural foods rich in polyunsaturated fatty acids.
4.4.3 Recall the presence of high concentrations of vitamin E in the rod and cone cells of the eye and their possible function.
4.4.4 Explain the negative relationship between antioxidants and atherosclerosis, aging and cancer.
4.4.5 Recall that vitamin E requirement is increased with increase in the polyunsaturated fat intake.

4.5 Vitamin K

4.5.1 Recall the characteristic structural features of vitamin K and its chemical name.

4.5.2 Explain the likely biochemical functions of vitamin K and state why it is referred to as the 'coagulation vitamin'.
4.5.3 List foods rich in vitamin K.
4.5.4 List the naturally occurring vitamin K antagonists and explain their mode of action.
4.5.5 Explain the rationale for the administration of vitamin K to preterm babies, patients with biliary obstruction prior to surgery and those with bleeding disorders.

4.6 Thiamin (Vitamin B_1)

4.6.1 Recall that thiamine was the first vitamin whose precise role in the body was stated in biochemical terms.
4.6.2 State the active form of thiamine and explain its role in energy metabolism.
4.6.3 Recall that vitamin B_1 is labile to heat at neutral and alkaline pH, but stable in acid pH.
4.6.4 Explain why thiamine requirement is based on energy requirement.
4.6.5 List the rich sources of thiamine.
4.6.6 Recall that 'Beri Beri' was a disease associated with highly milled rice and chronic alcoholism.
4.6.7 Explain why vitamin B_1 deficiency is uncommon in Sri Lanka.
4.6.8 List the principal signs and symptoms of Beri Beri.
4.6.9 Explain the advantages of consuming parboiled rice, lightly milled rice and cooked fish and of minimal washing of cereals and cut vegetables prior to cooking.
4.6.10 Explain why blood lactate levels is elevated in vitamin B_1 deficiency.
4.6.11 Recall that in chronic alcoholism, intestinal vitamin B_1 absorption and hepatic conversion of thiamine to TPP is reduced.
4.6.12 Recall that most of the thiamine in the nerve tissue is in the myelin sheath.

4.7 Riboflavin (Vitamin B_2)

4.7.1 Recall that it is yellow in colour and destroyed by sunlight and alkaline pH.
4.7.2 State the active forms of the vitamin and explain its role in energy metabolism.
4.7.3 State the signs and symptoms of ariboflavinosis.
4.7.4 Explain why urinary riboflavin levels increase markedly under conditions of negative nitrogen balance.
4.7.5 Explain why low income pregnant women and those on long term antibiotic treatment are at risk of developing riboflavin deficiency.
4.7.6 State the requirement of this vitamin.
4.7.7 State the rich sources of vitamin B_2
4.7.8 Explain how the riboflavin content of pulses is increased during partial germination.

4.8 Niacin (Vitamin B_3)

4.8.1 State the active forms and the reactions in which they take part.
4.8.2 Recall that niacin includes nicotinic acid and contributions from tryptophan.

4.8.3 Explain what is meant by the 3 'D' s associated with the deficiency of nicotinic acid.
4.8.4 State the excretory form and the route by which nicotinic acid is disposed.
4.8.5 Explain why nicotinic acid deficiency is common among maize eaters but not rice eaters.
4.8.6 Recall that those with nicotinic acid deficiency has a rough skin and hyperpigmentation of the skin exposed to sunlight.
4.8.7 Explain the bioavailability of nicotinic acid in maize following treatment with lime and partially germinated pulses.
4.8.8 Recall that Leucine : Isoleucine ratio is high in the maize Decan hybrid and is normal in maize Opaque 2.
4.8.9 Recall that therapeutic doses of nicotinic acid is used for lowering of blood triglycerides and cholesterol via inhibition of adipocytic lipolysis and VLDL synthesis
4.8.10 Explain why large doses of the vitamin could produce fatty liver in poorly nourished subjects.

4.9 Pantothenic Acid (Vitamin B $_5$)

4.9.1 Recall that it is called pantothenic acid because of its widespread distribution('pantos' = everywhere).
4.9.2 State its active form and state its biochemical role.
4.9.3 Recall that experimentally induced deficiency status result in fatigue and numbness & tingling of the extremities.
4.9.4 Recall that its deficiency is not seen in man and is not related to greying of hair in humans.

4.10 Pyridoxine (Vitamin B_6)

4.10.1 List the three different chemical forms of vitamin B_6 and state the two active forms.
4.10.2 Recall that it is heat stable.
4.10.3 List the different types of biochemical reactions where vitamin B_6 is used as aco-enzyme.
4.10.4 Recall that vitamin B_6 is used as a co-enzyme in the synthesis of serotonin from tryptophan and gamma amino butyric acid (GABA) from glutamic acid in the nerve tissue.
4.10.5 Explain how a deficiency in vitamin B_6 may lead to microcytic anaemia.
4.10.6 Recall that Royal Jelly in beehives is the richest source of vitamin B_6.
4.10.7 Recall that vitamin B_6 requirement varies with the protein intake.

4.11 Biotin

4.11.1 Recall that biotin is used as a co-enzyme in carboxylating reactions.
4.11.2 Recall that biotin is bound strongly to avidin in raw egg-white and is unavailable unless cooked.
4.11.3 List foods rich in biotin.

4.12 Folic Acid

4.12.1 Recall that folic acid is derived from the word 'foliage' which means 'leaves'.

4.12.2 Recall that folic acid may exist as a conjugate of glutamic acid where the number of glutamic acid residues varies from 1 to 7 and the monoglutamate form is called folic acid.
4.12.3 Recall that folic acid consists of a pteridine ring, para amino benzoic acid (PABA) and glutamic acid residues.
4.12.4 Recall that it is a heat labile vitamin and that only the mono-, di- and triglutamates are absorbed.
4.12.5 Recall that folate conjugase is inhibited by antiepileptics, oral contraceptives and bile acids.
4.12.6 State rich sources of the vitamin.
4.12.7 Describe the synthesis of the active form (tetra hydro folate, FH_4) from folic acid.
4.12.8 Recall the anti folate drugs that are used to inhibit the two intermediate steps in the synthesis of active folate from folate.
4.12.9 State the biochemical functions of folate and explain its role in the synthesis of purines and pyrimidines, methionine from homocysteine and in histidine metabolism.
4.12.10 Explain how a deficiency of folic acid can be identified by testing for urinary FIGLU after a histidine load test.
4.12.11 State how folate is transported in the blood and explain why the red cell folate is a better indicator of body folate status than the plasma level.
4.12.12 Recall that red cell folate reflects body stores whilst plasma folate reflects the current status.
4.12.13 State the daily requirement in the different physiological states.
4.12.14 Recall that folate stores in the liver are sufficient to meet the requirements of the body for 4 to 6 months.
4.12.15 Explain how folate deficiency may affect the blood picture and the haemoglobin level and the development of the neural tube in the first 4 weeks of intra-uterine life.
4.12.16 Explain the effect of folate deficiency on the intestinal mucosa and the bone marrow.

4.13 Vitamin B_{12} (Cyanocobalamin)

4.13.1 State why vitamin B_{12} is commonly referred to as cyanocobalamin.
4.13.2 Explain what is meant by pernicious anaemia.
4.13.3 State the contribution made by Whipple (1929), Minot and Murphy (1926) and Castle (1926) to our knowledge of pernicious anaemia and to the discovery of vitamin B_{12}.
4.13.4 Recall that gastric intrinsic factor (GIF) is a glycoprotein and that it protects and helps in the absorption of vitamin B_{12}.
4.13.5 State the rich sources and site of absorption of vitamin B_{12}.
4.13.6 Recall that vitamin B_{12} is a red crystalline solid that is stable towards heat at physiological pH.
4.13.7 Recall that it is transported in the plasma bound to the protein transcobalamin and stored in the liver and that the amount stored is sufficient to meet the requirements for over 2 years.
4.13.8 Recall that vitamin B_{12} is excreted via bile and reabsorbed via enterohepatic circulation at the ileum.
4.13.9 State the storage form of vitamin B_{12} in the liver.

4.13.10 Explain how vitamin B_{12} deficiency affects the haemoglobin level, the blood picture and neurological functions.
4.13.11 State the active forms of vitamin B_{12} and their functions.
4.13.12 Recall the clinical features that differentiates vitamin B_{12} deficiency from folate deficiency.
4.13.13 Explain why large amounts of methyl malonic acid, propionic acid, 4-amino-5-imidazole riboside (AICAR) appear in the urine of pernicious anaemia patients.
4.13.14 State the genetic defects that give rise to pernicious anaemia.
4.13.15 Explain the action of GIF antibodies (Type I and Type II).
4.13.16 List the causes of vitamin B_{12} deficiency and state why the red cell level is a better indicator of vitamin B_{12} status than the serum levels.
4.13.17 State the recommended allowance for a) adult b) pregnant c) lactating woman.
4.13.18 List the possible sources of vitamin B_{12} in a typical vegan diet and explain how culinary practices could be modified to improve the vitamin B_{12} content.

4.14 Vitamin C (Ascorbic Acid)

4.14.1 Recall that ascorbic acid is a reducing substance present in fruits and vegetables and readily destroyed by ascorbic acid oxidase present in them on exposure air.
4.14.2 List the signs and symptoms of scurvy.
4.14.3 List the changes seen in fibrous tissue, bone and teeth in ascorbic acid deficiency. Correlate these with the role of the vitamin in the formation of collagen, dentine and intracellular ground substance.
4.14.4 State the relationship between ascorbic acid deficiency and adrenal insufficiency.
4.14.5 Explain the functions vitamin C in
4.14.5.1 Iron absorption
4.14.5.2 Erytropoiesis.
4.14.6 Recall the role of vitamin C as an antioxidant in the maintenance of red blood cells and the reduction of atherosclerosis and cancer.
4.14.7 State the role of vitamin C in phenylalanine metabolism.
4.14.8 Recall that large doses (1-2 g/day) of vitamin C does not offer protection against infection.
4.14.9 Explain the relationship between a large intake of daily vitamin C and oxaluria.
4.14.10 State the recommended daily allowance (RDA) of the vitamin for a meat eating adult and a vegan.
2.14.11 Explain the rationale for the increase in the recommended vitamin C dose to 100 mg for smokers.
4.14.12 State rich sources of vitamin C and how it can be increased in seeds during food processing.
4.14.13 State how losses during food preparation could be minimized.

4.15 Vitamin H (Essential Fatty Acids)

4.15.1 Explain why linoleic acid (9,12-C18:2) and gamma linolenic acid (6,9,12-C18:3) are essential to man.

4.15.2 Recall that arachidonic acid (5,8,11,14 - C20:4) is a dispensable nutrient as it can be synthesized from linoleic and gamma linolenic acid.
4.15.3 Explain the role of essential fatty acids in membrane function and the transport and oxidation of cholesterol.
4.15.4 Recall the role of essential fatty acids in prostaglandin formation.
4.15.5 Discuss the association of essential fatty acids in atherosclerosis and blood clotting.
4.15.6 Recall that it is the cis-form of EFA that is naturally found and that linoleic acid has a predominantly cholesterol lowering effect, whilst linolenic acid has an anticlotting effect.
4.15.7 Recall that during hydrogenation of polyunsaturated fatty acids, cis- changes to trans- and that it becomes non functional

5. Minerals

5.1 General

5.1.1 List the seven major macro minerals and the nutritionally important micro minerals.
5.1.2 Define a micro mineral and explain how it differs from a macromineral.
5.1.3 Recall the principal sites of mineral distribution in the body and the content ofnutritionally important minerals.

5.2 Sodium and Potassium

5.2.1 Recall that the average daily intake of salt in Sri Lanka is 7 grams and that it is the major contributor towards the sodium intake.
5.2.2 Recall that fruits are rich sources of potassium
5.2.3 Recall that a minimal intake of sodium is essential for the normal cellular function and excessive losses in the body may result in muscle cramps.
5.2.4 Recall that cereals, pulses and vegetables are low in salt content.
5.2.5 Recall that cells are maintained in a dynamic state via the Na^+- K^+ pump which uses 40% of the basal metabolic energy.

5.3 Calcium and Phosphorus

5.3.1 Recall that calcium and phosphorus are metabolically inter-related in the plasma and explain their relationship in terms of the solubility product of calcium phosphate.
5.3.2 State the normal range for serum calcium and phosphate and state the different forms in which calcium exists in the serum.
5.3.3 List the functions of calcium in the body.
5.3.4 Recall that Ca in extracellular fluid is maintained constant by exchanges between extracellular fluid and bone, and by absorption and excretion.
5.3.5 Draw and label a transection of bone.
5.3.6 State the percentage of water, mineral and organic material in bone.
5.3.7 State the proportion of collagen, ground substance and lipid in the organic fraction and their likely function.
5.3.8 State the structural features of collagen and ground substance of bone which make them suitable material for the deposition of bone mineral.
5.3.9 Name the cells that secrete protocollagen.

5.3.10 Recall that collagen forms 1/3 of the total body protein.
5.3.11 Recall the role of ascorbic acid in collagen formation.
5.3.12 Describe the functions of osteoblasts and osteoclasts.
5.3.13 Explain what is meant by bone remodelling and the advantage to the body of this process.
5.3.14 State the role of retinol in bone remodelling.
5.3.15 List the factors that effect the absorption of calcium in the intestine and explain their mode of action.
5.3.16 Explain "adaptation to low calcium intake" and the part played by calciferol in this process.
5.3.17 Explain the role of "blood-bone equilibrium" in maintaining the level of serum calcium. State the action of Parathormone, Calcitonin, 1,25 dihydroxy cholecalciferol and the kidney in this process.
5.3.18 State the recommended allowances of calcium for infants, children and adults and during pregnancy and lactation.
5.3.19 Recall that bone maturity is attained by the 25^{th} year and that any attempt to accelerate calcium deposition should be done prior to that. (See objective 2.3.12)
5.3.20 Name the rich sources of calcium in the Sri Lankan diet giving the approximate content of each.
5.3.21 Explain the contribution of calcium from water, green leaves, manioc and small Fish.
5.3.22 Draw and label the histological appearance of the longitudinal section of a tooth.
5.3.23 Recall that phosphorus is a common constituent of all living tissues.
5.3.24 Recall that bone mineral consists of calcium, phosphorus and fluoride and is present as fluoroapetite.

5.4 Iron

5.4.1 Explain why iron deficiency is one of the commonest deficiencies suffered by man in spite of iron being found in abundance in the earth's crust and biosphere.
5.4.2 State the clinical features of iron deficiency.
5.4.3 State how iron is distributed in different tissues and the approximate amount in each.
5.4.4 Recall that iron is toxic to cells and explain how the body is protected againstabnormal concentrations of iron.
5.4.5 State the storage forms of iron and the tissues which store them.
5.4.6 State the iron form/s that (i) passes through the cell membrane (ii) exist in cells (iii) is found in the blood.
5.4.7 State how iron is transported in the blood. State the properties of transferrin.
5.4.8 Define Total Iron Binding Capacity (TIBC) and percentage saturation of transferrin (PS). State the normal values for these.
5.4.9 State how PS varies with the time of the day in iron deficiency, in nephriticsyndrome and in infectious disease.
5.4.10 State the functions of haptoglobin.
5.4.11 List the factors that influence the absorption of dietary iron and explain their mode of action.
5.4.12 Explain how intestinal absorption is influenced by (i) age (ii) sex

(iii) physiological status and (iv) iron deficiency.

5.4.13 Explain why after a quick ascent from sea level to an altitude of 5000 feet, there is a four fold increase in iron absorption. Then after a month at that altitude, absorption rate returned to its original level. When brought back to sea level,
iron absorption stops for a few days. Explain.

5.4.14 List the foods rich in iron and state the approximate iron content of each.

5.4.15 State the effect of (i) egg yolk (ii) cereals, on the absorption of medicinal iron.

5.4.16 Describe an experiment to demonstrate that vitamin C enhances the absorption of dietary iron.

5.4.17 State the percentage of iron absorbed from a mixed diet by a (i)man (ii)pre-school child (iii) iron-deficient child (iv)menstruating woman (v)lactating woman.

5.4.18 State the amount of iron lost by a man in (i) urine (ii) faeces (iii) sweat.

5.4.19 State the loss of iron during menstruation. Explain how this is computed as a daily loss.

5.4.20 Compute the iron requirements of a man, a menstruating woman, an infant, a child and an adolescent.

5.4.21 Compute the net cost of pregnancy with respect to iron, taking into account the expanded maternal red cell mass and foetal and maternal requirements.

5.4.22 State how much of iron is secreted in milk. State the daily requirements during lactation.

5.4.23 The American Medical Association has recommended that in the public interest, wheat flour should be enriched with iron. Explain. State the common forms of iron used for food fortification.

5.4.24 State what items of Sri Lankan diet could be considered for iron fortification and
discuss the merits and demerits of each one of them.

5.4.25 Discuss the value of haemoglobin concentration as an indicator of iron deficiency.

5.4.26 Discuss the value of serum ferritin as an indicator of storage iron.

5.5 Iodine

5.5.1 Recall that the physiological role of iodine is synthesis of thyroid hormone.

5.5.2 Explain the term "iodine pool" and list the organs that add to, and those that remove iodide from the pool.

5.5.3 Recall that urinary iodide may be used as an indicator of dietary iodine intake and
that a value of 25 ug per litre or less, indicates iodine deficiency.

5.5.4 Design an experiment to show that thyroid traps iodide ions.

5.5.5 Outline the sequence of events which convert the trapped iodide into hormonal iodine.

5.5.6 Outline the events that promote the secretion of the thyroid hormone.

5.5.7 State the factors that (i) stimulate (ii) inhibit, the sequence of events from trapping of iodide to release of T_3 and T_4.

5.5.8 List the forms in which iodide is present in the blood plasma, stating the

approximate concentration of each and the proteins to which they are bound.

5.5.9 State the fate of T_3 and T_4 in (i)liver (ii)extra- hepatic tissues.

5.5.10 List the actions of the thyroid hormone.

5.5.11 Recall the importance of iodine in foetal development and the derangements resulting from iodine deficiency.

5.5.12 Explain the importance of iodine during adolescence, pregnancy and lactation.

5.5.13 List the foods rich in iodide. Recall that the same food produced in different parts of the country could vary in its iodide content.

5.5.14 Recall that water contributes substantially to the daily requirement of iodine in the dry zone and areas using deep well water.

5.5.15 Recall that 2.5 ug of iodide per litre is used as the cut off point in drinking water to differentiate goitrogenous population from the rest, but in the Sri Lankan context 10 ug of iodide per litre is a better cut off point.

5.5.16 Explain how common salt is iodized and compare the merits of using KI and KIO_3 as an iodide supplement.

5.5.17 Explain the term "endemic goitre". Recall that thiocyanate, perchlorate and goitrin are three common goitrogens present in vegetables and explain their mechanism of action.

5.5.18 List the (i) nutritional and (ii) non-nutritional factors that may lead to goitre.

5.5.19 State the regions of Sri Lanka in which goitre is endemic. Explain how this condition interferes with the work potential of the people concerned. Give reasons for goitre being endemic in fishing villages between Negombo and Matara.

5.5.20 State what steps you would take to reduce the incidence of endemic goitre.

5.5.21 Recall that cooking of food containing souring agents results in the loss of iodine.

5.5.22 Recall that phenolic compounds trap iodine and makes it unavailable to the body.

5.6 Fluorine

5.6.1 Explain why fluorine can displace hydroxyl in the crystal lattice of bone mineral.

5.6.2 Explain the association of fluorine with dental caries. Explain the effect of dietary F in reducing dental caries of (1)a pre-school child (2)an adult.

5.6.3 Describe the changes in teeth in dental fluorosis. State what intake of F could produce dental fluorosis.

5.6.4 State the effect of excessive intake of F on the bone.

5.6.5 Recall that tea and sea foods are the richest sources of F and that the F concentration of a cup of tea on an average is nearly 1 ppm.

5.6.6 State how you would increase the intake of F in regions where a pipe borne water supply is not available.

5.6.7 State how the concentration of F in drinking water could be reduced.

5.6.8 State the areas of Sri Lanka where there is a high incidence of dental fluorosis.

5.6.9 Recall that 0.6 - 0.8 ppm is a satisfactory F concentration in drinking waterto reduce dental caries.
5.6.10 Recall that the F concentration of drinking water from deep wells and from the dry zone are rich in F and that burnt clay can be used for defluoridation.
5.6.11 Recall that osteoporosis is a common age related bone disease that could be delayed by an optimal level of F intake (1 ppm) during the growth phase.
5.6.12 Recall that F rich bone is resistant to acid hydrolysis.

5.7 Copper

5.7.1 Recall that deficiency can occur only in extreme conditions.
5.7.2 List the foods rich in copper and state the daily intake from a mixed diet. State what percentage of this is absorbed.
5.7.3 State the recommended allowances for a rapidly growing infant, for older children and for adults.
5.7.4 Recall that cow's milk is a poor source of copper.
5.7.5 State what is ceruloplasmin and its function.
5.7.6 Recall that copper plays a role in the activity of hydroxylases and its deficiencycould leads to inhibition of post translational modifications.
5.7.7 Explain the effect of copper deficiency on hair, elastic tissue, bone and erythropoiesis.

5.8 Zinc

5.8.1 List the evidence that indicates that sexual maturation, growth and development in man depends on adequate, available dietary zinc.
5.8.2 List the signs and symptoms associated with primary zinc deficiency.
5.8.3 State the role of zinc in the synthesis of nucleic acids and proteins.
5.8.4 List the symptoms of zinc toxicity.
5.8.5 State the requirement of zinc for an infant and for a pre-school child.
5.8.6 List the foods rich in zinc.
5.8.7 List the factors in the diet that influence Zn absorption

5.9 Selenium

5.9.1 State the biochemical functions of selenium
5.9.2 State the association between selenium and vitamin E
5.9.3 List the foods rich in selenium.
5.9.4 Recall that selenium could replace sulphur in proteins and recall that selenium is a constituent of deiodinase and a deficiency would lead to reduced levels of T_3.
5.9.5 Explain the possible relationship of selenium deficiency and goitre.
3.9.6 Recall that selenium in hair could be used as an indicator of selenium statusin the body.

5.10 Magnesium

5.10.1 Recall that magnesium is a major intracellular cation of animals and plants.
5.10.2 State in which conditions there could be a deficiency of magnesium.
5.10.3 State the signs and symptoms attributable to magnesium deficiency.

5.11 Manganese

5.11.1 State what changes have been described in animals with manganese deficiency.
5.11.2 State what conditions in man are associated with (i) manganese deficiency ii) manganese toxicity.
5.11.3 List the foods rich in manganese.
5.11.4 State the functions of manganese.

5.12 Chromium

5.12.1 Recall that chromium is referred to as the glucose tolerance factor.
5.12.2. Explain the relationship between chromium deficiency and the intravenous glucose tolerance test.
5.12.3 Explain the likely reason for diabetics to be prescribed chromium.
5.12.4 Recall that yeast, mushroom and condiments are rich sources of chromium.

6. Fibre

6.1 General

6.1.1 Recall that the term fibre refers to plant fibre and that these are resistant to digestion.
6.1.2 Recall that fibre include, cellulose, pectin, hemicellulose and other indigestible polysaccharides.
6.1.3 Recall that fibre is made up of soluble and insoluble types and their general physical characteristics.
6.1.4 Recall that flatulence is caused by bacterial action on plant polysaccharides like raffinose and stachyose.
6.1.5 Explain how flatulence among pulse eaters could be minimized.
6.1.6 Recall that the bioavailability of nutrients especially those of microminerals is affected by fibre.
6.1.7 Explain how dietary fibre can be used in the treatment of obesity.

6.2 Soluble Fibre

6.2.1 State the names of major soluble fibre in the diet.
6.2.2 Explain the mechanisms involved in lowering of blood glucose and blood cholesterol by these.

6.3 Insoluble Fibre

6.3.1 Name the major types of insoluble fibre and explain their physical characteristics.
6.3.2 Explain the likely action of insoluble fibre in reducing diverticular disease, haemorrhoids and colonic cancer.

7. Anthropometric measurements

7.1 General

7.1.1 Recall that anthropometric measurements are physical measurements to monitor growth and health status.
7.1.2 List the different anthropometric parameters used in health studies.

7.2 Paediatric Anthropometry

7.2.1 Recall weight-for-age, height (or length)-for-age, weight-for-height and head:chest circumference ratio are used as indicators of growth and nutritional status.

7.2.2 Explain why it is necessary to monitor the weight and height of a child at least upto years.

7.2.3 Explain why it is necessary to do serial measurements rather than one measurement.

7.2.4 Recall that children are considered to be over-weight when their body weight exceeds 20% of the median or the 50th percentile.

7.2.5 Recall that comparisons are done using results of the 50th percentiles of the National Centre for Health Statistics (NCHS) for US children.

7.2.6 State the height (or length)-for-age % values when defining mild, moderate and severe stunting in children.

7.2.7 State the weight-for-height percentages when defining wasting as mild, moderate and severe.

7.2.8 State Gomez weight-for-age nutritional class classification.

7.2.9 Recall the Waterlow classification and its drawback in the case of weight-for-height measurements.

7.3 Adult Anthropometry

7.3.1 Ideal Body Weight

7.3.1.1 Recall the equations used in the calculation of ideal body weight for men and women and calculate them when data is given.

7.3.1.2 Recall that ideal body weight is dependant on the body frame.

7.3.1.3 Classify the body frame to small, medium and large by measuring the elbow width.

7.3.2 Body Mass Index

7.3.2.1 Define 'Body Mass Index' and state the normal range.

7.3.2.2 State the body mass index ranges for each of the grades of chronic energy deficiency in women.

7.3.2.3 Explain the use of the body mass index in defining obesity.

7.3.3 Waist-to-hip Ratio

7.3.3.1 Recall that fat deposited in the upper and lower parts of the body are distinct in size and function.

7.3.3.2 State the normal waist-to-hip ratio for men and women.

7.3.3.3 Explain the risk associated with high levels of waist-to-hip ratios.

7.3.4 Mid Arm Circumference and Skin Fold Thickness

7.3.4.1 Recall that the mid arm circumference and skin fold thickness are indicators of fat in the body.

7.3.4.2 Recall that skin fold measurements are made at the biceps, triceps and subscapular areas.

7.3.4.3 Calculate the composition of fat using the equation for skin fold thicknesses.

7.3.4.4 Recall that composition of fat is better computed by weighing in air and under water.

8. Foods

8.1 General

8.1.1 Recall the principal class/es of food that contribute energy, protein, minerals and vitamins.

8.2 Cereals

8.2.1 Recall that cereals are domesticated grasses. List the principal cereals.

8.2.2 List the nutrients supplied by cereals. State the nutrients which are deficient in cereals.

8.2.3 Draw and label a longitudinal section of a grain of rice.

8.2.4 State the differences between lightly-milled "raw" rice, highly milled "raw" rice, lightly milled "parboiled" rice and highly milled "parboiled" rice in appearance and content of nutrients.

8.2.5 State what nutrients are lost during milling, washing and boiling of rice. Explain how these losses could be minimized.

8.2.6 Describe the two different process of "parboiling of rice".

8.2.7 State how rice is enriched. State whether you would advocate rice enrichment as a national policy. Give reasons.

8.2.8 Explain the meaning of the term ' extraction rate' when applied to wheat flour. Recall that bread made from all types of flour is easily digested by healthy people.

8.2.9 State what gives bread its spongy texture. Explain why only wheat and rye bake into leavened bread.

8.2.10 State why it is easier to enrich bread than rice.

8.2.11 Recall that up to 20% manioc flour could be added to wheat flour when making bread without a significant alteration in texture and that bread made with wheat flour fortified with 10% soy flour keeps better.

8.2.12 Recall that Ata flour is 93-95% extraction wheat flour.

8.2.13 Explain how the nutritive value of maize differs from that of other cereals. Recallthe biological value of maize protein and compare it with those of rice and wheat.

8.2.14 Explain what is meant by opaque-2-maize. State how it differs from the common variety of maize.

8.2.15 List millets commonly eaten in Sri Lanka. Explain the disadvantages that would occur if rice were to be totally replaced by sorghum.

8.2.16 Explain the importance of Kurakkan as a source of micro minerals and as an important component of the diabetic diet.

8.3 Starchy Roots and Tubers

8.3.1 Recall that manioc is a drought resistant crop and is likely to be eaten in large quantities during periods of drought.

8.3.2 List the cyanogenic glucosides present in manioc. List other foods that contain the glucosides.

8.3.3 State the conditions under which hydrocyanic acid may be liberated from cyanogenic glucosides.

8.3.4 State what precautions should be taken when cooking manioc.

8.3.5 Recall that signs of chronic poisoning are more prevalent in populations that eat three or four meals of manioc each day.
8.3.6 State why manioc flour may be used in making bread, pittu or string hoppers but is less safe for making rotti.
8.3.7 State how detoxified manioc flour may be prepared
8.3.8 Outline the reactions involved in detoxifying cyanide in the body.
8.3.9 State the relationship between cyanide detoxification and adequacy of dietary protein. Name the supplementary foods that should be provided when manioc is eaten in large quantities.
8.3.10 Recall that substituting manioc for part of the rice in the diet results in improved rate of growth of children, provided the diet is well balanced. Give reasons for this observation.
8.3.11 Explain why potato is a popular food throughout the world. State the nutrients that are supplied by it.
8.3.12 Compare sweet potato with potato with regard to their nutrient content and the biological values of their proteins.
8.3.13 Explain why starchy roots and tubers cannot be regarded as a substitute for rice but only as supplements to rice diets.

8.4 Pulses

8.4.1 Define the terms "pulses", "gram" and "dhal".
8.4.2 List the pulses commonly consumed in this country.
8.4.3 Compare the digestibility of pulses with that of rice. What are the effects of (i) soaking (ii) removal of husk (iii) heating (iv) germination (v) fermentation, on the digestibility of pulses and on their nutritive value?
8.4.4 Compare the nutritive value of pulses with that of rice.
8.4.5 Compare the nutritive value of soy bean with that of other pulses grown in this country.
8.4.6 Explain why the general population has not accepted soy bean as it has done to other pulses. State what you would do to make Soya more acceptable to them.
8.4.7 State how ground nut differ in nutritive value from other pulses.
8.4.8 Discuss the nutritive value of winged bean as a fresh vegetable and a legume.
8.4.9 List the toxic substances present in legumes. Explain the action of haemagglutinins, saponins and cyanogenic glucosides present in varying quantities in pulses. Explain why they do not present a serious problem in human nutrition.
8.4.10 Explain the feeling of abdominal discomfort that might be experienced after consumption of more than 02 ozs of a pulse.

8.5 Vegetables and Fruits

8.5.1 List the different varieties of leaves eaten in Sri Lanka. Recall that in all parts of the island, locally grown green leafy vegetables are available in adequate quantities.
8.5.2 List the nutrients that are added to the diet by green leafy vegetables. Recall that dark green leaves contain more nutrients than light green leaves.
8.5.3 Compare the biological value of leaf proteins with those of rice and milk.

8.5.4 Recall that the cellulose wall of plant cells reduces the availability of nutrients contained in the cell. State how you would overcome this.
8.5.5 List the factors present in leaves that (i)hinder (ii)assist in the absorption of Ca and Fe present in the leaves.
8.5.6 Recall that manioc leaves are rich in protein and contain cyanogenic glucosides. State how these leaves should be prepared for human consumption.
8.5.7 State why leaves should be eaten along with fat.
8.5.8 List the nutrients supplied by the different types of fruit vegetables. Explain why yellow pumpkin is more nutritious than other gourds.
8.5.9 Explain why ripe fruits are considered an important item of the diet.
8.5.10 List the organic acids present in various fruits. Outline the fate of these acids in the body.
8.5.11 Explain why the consumption of fruits lead to the excretion of alkaline urine.
8.5.12 List the fruits grown in Sri Lanka that are rich sources of (i)ascorbic acid (ii)carotene

8.6 Seeds and Nuts

8.6.1 State the approximate composition of coconut kernel. State the proportion of fat and protein in the kernel that is squeezed out when preparing coconut milk.
8.6.2 State why kernel is a good supplement to a rice diet.
8.6.3 State how optimal use of the grated coconut can be obtained when making curries.
8.6.4 State the approximate fat content of the Sri Lankan diet and proportion of fat supplied by coconut.
8.6.5 List the nutrients supplied by sesame seeds. Compare the nutritive value of sesame oil with that of coconut oil. State why it is better to crush the seeds before eating sesame.
8.6.6 State the nutritive value of (i) cashew fruit (ii) cashew nut.

8.7. Meat

8.7.1 State why protein of animal origin is not essential.
8.7.2 State why a high intake of beef, mutton and pork is considered harmful.
8.7.3 Compare the nutritive value of beef and mutton with that of pulses.
8.7.4 Explain why fresh meat is tough and how it could be tenderized.
8.7.5 State the nutrients that are added to a rice diet by beef. State the nutrients that are deficient in meat.
8.7.6 State whether the meat of poultry is superior to beef or mutton. Give reasons.
8.7.7 State the advantages of including meat in the diet.
8.7.8 List the nutrients in which organ meats such as liver and kidney are rich.
8.7.9 List the advantages and disadvantages of eating brain.
8.7.10 State the importance of meat extracts such as Bovril in nutrition.

8.8 Fish

8.8.1 Compare the nutritive value of fish with that of meat.
8.8.2 State the disadvantage of eating raw fish.
8.8.3 List the principle involved in sun-drying salted fish.

8.8.4 Recall that crustaceans (crabs, prawns) are considered as "heaty foods". Give reasons for it.
8.8.5 State whether sea fish is more nutritious than fresh-water fish.
8.8.6 State why red fish is more nutritious than white fish.

8.9 Egg

8.9.1 State the approximate composition of (i)egg yolk (ii)egg white. State the proportion of egg that is the shell.
8.9.2 State what nutrients are added to the diet by egg. State in which nutrients egg is deficient.
8.9.3 State what is the "egg-white injury" syndrome. State how this could be avoided.
8.9.4 Explain why it could be advantageous to eat duck's eggs instead of hen's eggs.
8.9.5 Explain why duck's eggs should be well cooked before they are eaten.
8.9.6 Explain what is meant by "whole-egg protein". Explain why "whole-egg protein" is used as a reference protein.
8.9.7 Explain why medicinal iron should not be given along with a meal that includes egg.

8.10 Milk

8.10.1 Recall that milk secreted by the mammary gland is the most complete single food for the newborn.
8.10.2 State what explanation can be given for man domesticating herbivore for his supply of milk. State why the pig, which has a greater lactation potential has not been used as a milking animal.
8.10.3 Recall that more rapid the development of the young of any species, the higher the mineral and protein content of the milk of that species.
8.10.4 List the constituents of the aqueous phase, the lipid phase and of the non fat solids, of milk.
8.10.5 Recall the reaction sequence in the synthesis of lactose.
8.10.6 Explain why cow's milk tastes less sweet and more salty as lactation is prolonged.
8.10.7 State the advantage of lactose over the other sugars as the carbohydrate constituent of milk.
8.10.8 State the significance of the bifidus factor in human milk.
8.10.9 Outline the reactions involved in the clotting of milk.
8.10.10 List the proteins in milk and state their possible functions.
8.10.11 List the fatty acids found in high concentration in milk. Recall that the infant derives most of its energy from milk fat. State how fat in human milk differ from that of ruminants.
8.10.12 Recall that milk is a poor source of iron.
8.10.13 Recall that milk is a good source of retinol and the B vitamins. Explain the relationship between the vitamin content of the mother's diet and that of her milk.
8.10.14 Discuss the role of cow's milk in the diet of a (i) pre-school child (ii) school child (iii) pregnant and a lactating woman.
8.10.15 Explain how fermented milk is prepared and the advantage of fermented milk as (i) a weaning food (ii) a supplementary food for children and

adults. State how fermented milk differs from yoghurt. State why buffalo milk is preferred to cow for making fermented milk.

8.10.16 State how cheese, butter and ghee are made and state their contribution to the diet.

8.10.17 State how milk is pasteurized and how pasteurized milk differs from sterilized milk.

8.10.18 State the advantages and disadvantages of dried skim milk over dried full cream milk.

8.10.19 List the advantages of human milk over cow milk for infant feeding. Explain why it is necessary to feed the newborn as soon as possible after birth.

8.10.20 State the effects of lactation on (i) ovulation (ii) incidence of breast cancer.

8.10.21 State the psychological effect of breast feeding on mother and child.

8.11 Food Processing and Cooking

8.11.1 List the qualities of a food that are improved by cooking.

8.11.2 List the principle methods of cooking employed in Sri Lanka.

8.11.3 Explain how the vitamin content of the food may be altered by boiling and how this be minimised. Compare the advantages of steaming with boiling of vegetables.

8.11.4 Explain why vegetables may be discoloured during boiling and how this could be avoided.

8.11.5 Describe the effect of boiling and stewing on meat. State how nutrient losses can be minimised. Explain the browning of meat during cooking.

8.11.6 Boiling reduces the flavour of fish, whereas methods of cooking fish employed in this country tend to enhance the flavour. Explain.

8.11.7 Explain why deep frying of vegetables, meat and fish is preferable to shallow frying.

8.11.8 Explain the changes that take place in an egg when it is boiled. Explain the black coating round the yolk of a hard boiled egg and how this may be avoided. State what nutrients are lost when eggs are cooked.

8.11.9 Describe the losses of nutrients during storing, milling, washing and boiling of rice, and state how they could be minimised.

8.11.10 Explain the nutritive advantage of converting wheat flour into bread and state the nutrient losses that take place during baking and toasting. Describe how the process of biscuit making differs from bread making. Explain how some amino acids are made unavailable for intestinal absorption during baking.

8.11.11 Explain how grinding of condiments, grated coconut, and of green leaves affects the availability of nutrients for intestinal absorption.

8.11.12 Describe the processes involved in making pasteurized milk, sterilized milk, milk powders, condensed milk and curd. State the nutritional advantages and disadvantages of each of these products.

8.11.13 Explain the effects of the cooking utensil on the nutrient content of the cooked food. State why pots made of cast iron or earthenware be preferable to these made out of aluminium. State why galvanized ironware and enamelware be avoided.

9. Food Composition Tables & Diet

9.1 Know the limitation regarding the bioavailability of nutrients listed.

9.2 Recall that the water content of vegetables, yams and stored grain could vary considerably. State how the water content is assessed.

9.3 Know how the protein content of the food is estimated and the sources of error in the methods.

9.4 State how the carbohydrate content of a food is derived and distinguish between available and non-available carbohydrate.

9.5 State how the energy content of a food is derived and indicate the possible sources of error in these estimates.

9.6 Estimate difference between the weight of a food "as purchased" and its "edible portion" and how the percentage of "refuse" is derived.

9.7 Explain the wide variation in the percentage of "refuse" discarded from a particular food when preparing a meal, and recall that food composition tables can give only approximate figures for "refuse".

9.8 Explain what is meant by a "balanced diet".

9.9 Explain the composition of weaning food and state at what age it is best introduced, giving reasons.

9.10 Explain what changes in the diet should be made with advancing age.

9.11 Know how the essential amino acid requirement changes with age and explain why it is necessary to supply good quality protein to children instead of the breadwinner, in case of a food scarcity.

9.12 State the capacity of the stomach of a one year old child and how much energy and protein should be supplied by the diet. Explain why very young children should be given solid foods several times per day.

9.13 State the average weight of an adult Sri Lankan man/woman. Assess your own energy and protein requirements. Draw up a balanced diet for yourself assuming you are a vegetarian.

9.14 Using the food composition tables, calculate the nutrients derived from 300g parboiled rice, 100g wheat flour, 50g cowpea, 25g dried fish and 50g mukunuwenna. State the additional quantities of the same foods that would be required if any, to provide 10.46MJ (2,500Kcals) of energy, 50g protein, 400mg calcium, 10mg iron, 750mg retinol equivalents, 1mg thiamine, 1mg riboflavin and 50mg ascorbic acid.

10. Diet Therapy

10.1 Explain the constituents that need to be included in a beverage to rehydrate a child with diarrhoea. State how these could be provided using common ingredients in a kitchen.

10.2 State the advantages of using lime and tamarind as souring agents.

10.3 Why is it necessary to provide a diet containing sufficient energy and good quality protein to a child recovering from measles and diarrhoea.

10.4 Explain the type of diet that should be recommended to those with liver damage, kidney dysfunction, constipation, hypercholesterolaemia, hypertension, obesity, diabetes mellitus, lactase deficiency, phenylketonuria, galactosaemia and gout, etc.

10.5 Explain what dietary measures need to be taken when treating iron deficiency vegans, endemic goitre, protein energy deficient pre-school children, B-complex deficient pregnant women etc.

11. Dietary Practices in Health & Disease

11.1 Infancy and Childhood

11.1.1 Explain why it is important to feed a baby as soon as possible, after birth.

11.1.2 Recall that the act of feeding is important to the young child not only because of the nutritive value, but also because of the emotional and psychological at benefits derived.

11.1.3 Explain the importance of breast milk in infant feeding and recall that a mother should be encouraged to breast feed a child as long as she can.

11.1.4 Recall the composition of breast milk and compare it with cow's milk.

11.1.5 Recall that during the 2nd year, breast milk provides a substantial amount of energy, even if a staple diet is given.

11.1.6 Recall that there are only a few contra-indications to breast feeding and state these.

11.1.7 Recall that pre term babies who haven't developed the sucking reflex need to be given expressed breast milk.

11.1.8 Recall that in the early morning, the quantity and quality of milk produced by the mother is higher than at other times of the day. Give a biochemical explanation for this.

11.1.9 Describe the difference between foremilk and hindmilk.

11.1.10 Recall that the adequacy of the diet is best inferred by weighing the baby regularly.

11.1.11 State why it is best not to give anything orally other than milk during the first 4 months.

11.1.12 Explain the meaning of the word 'weaning' and state why the phrase 'food supplementation' is preferred instead of 'weaning'.

11.1.13 Recall that semi solid food is introduced according to the child's growth pattern at around 4 months of age.

11.1.14 Explain the importance of rice as compared to wheat in infant feeding.

11.1.15 State the types of food that can be given to an infant.

11.1.16 Recall that it is best to give a child 3 meals a day (an adult diet) by the age of 1 year.

11.1.17 Recall that the components of a balanced diet of a 1 year old includes a staple food like rice, a pulse, animal protein, leafy vegetables and fruits.

11.1.18 Explain the importance of green leafy vegetables in the preparation of supplementary foods and the correct way of processing them.

11.1.19 Explain why salt, spices and sweets are best avoided during the early years.

11.1.20 Recall that formula milk is modified cow's milk.

11.1.21 Explain how cow's milk should be modified when given to an infant up to 6 months of age.

11.1.22 Explain the difference in the composition of milk formula I and II and state when they are fed.
11.1.23 Recall that full cream milk can be given after 1 year.
11.1.24 Recall that lactose free milk is given in lactose intolerance and galactosaemia and soya preparations are given in certain allergic conditions.
11.1.25 Explain the importance of small frequent feeds in young children.
11.1.26 Explain the importance of fat as a source of energy in early childhood.

11.2 Illness

11.2.1 Explain why a child needs increased amounts of good quality food during an illness.
11.2.2 State the types of food that can be given to an ill child.
11.2.3 Recall that an ill child needs plenty of fluid during an illness.
11.2.4 Recall that an infection (eg: measles) can cause wasting and state ways of combating under nutrition in those afflicted with measles
11.2.5 Recall that breast feeding should be promoted during illness.

11.3 Diarrhoea

11.3.1 Explain how diarrhoea can lead to dehydration and under nutrition.
11.3.2 Recall that a child with diarrhoea needs more fluid and nutrients than usual.
11.3.3 List the types of food that can be given to a child with diarrhoea.
11.3.4 Describe the role played by oral rehydration salts (eg: Jeewani) in the management of diarrhoea.
11.3.5 Describe how oral rehydration salts are reconstituted.

11.4 Marasmus

11.4.1 Recall that marasmus is a severe form of malnutrition and that it is an adaptation to mainly an energy deficit.
11.4.2 Explain why marasmus is usually seen in children below 1 year.
11.4.3 Recall that the management of marasmus is not only dietary, but that there is also a medical, social, emotional and educational aspect to it and that the mother's ignorance is a likely important reason.
11.4.4 Recall that during the early recovery phase, the child is given small frequent feeds of diluted milk, sugar other than lactose, moderate amounts of high quality protein, vitamins and minerals.
11.4.5 Recall that during catch-up growth, the child is given high energy feeds, plenty of food and protein in an easily digestible form and micronutrients.
11.4.6 Recall that a child who has recovered from marasmus needs to continue on a balanced diet.
11.4.7 Recall that the best food in the management of marasmus should be high in energy and protein, and easily digested.

11.5 Adolescence

11.5.1. Recall that adolescence is the age around puberty. (WHO 10-18 years) and leads to a change in the body composition.

11.5.2. Recall that an increase in physical growth, maturation and psychosocial changes do occur during adolescence.
11.5.3. Recall that the growth velocity during adolescence is around 0.25 mm per day.
11.5.4. Recall that increased growth velocity increases the appetite.
11.5.5. Recall that even though the energy and protein requirement per kg body weight falls to adult values during adolescence, the total requirement increases due to increased body weight.
11.5.6. Recall that the vitamin and mineral requirement increases during adolescence.
11.5.7. Explain why a negative nitrogen balance is sometimes seen in adolescence (due to stress) and state the urinary changes that accompany it.
11.5.8. State the likely reasons for an increased incidence of physiological goitre and anaemia, especially in females during adolescence.
11.5.9 Describe the dietary measures that could be taken to overcome iodine and iron deficiency in adolescence.
11.5.10 Explain why adolescent obesity may emerge as a future problem, in spite of better education via electronic media.

11.6 Middle age

11.6.1 Recall that aging is a continuous process throughout life.
11.6.2 Recall that by delaying or preventing the early stages of aging, better health maybe achieved in the older years.
11.6.3 State the features associated with the aging process.
11.6.4 Recall that throughout adult life, there is a progressive reduction in lean mass and a compensatory accumulation of adipose tissue.
11.6.5 Explain the fall in metabolic rate with age.
11.6.6 State why obesity prevalence increases steadily with age and why there is sex difference.
11.6.7 State the ways in which the onset of obesity could be prevented.
11.6.8 Recall that osteoporosis begins around the age of 40 years.
11.6.9 Recall that it is desirable to achieve a high bone mass by the age of 20-30 years, to minimize the effects of later osteoporosis.
11.6.10 Describe the dietary and other factors that maybe involved in determining the bonemass.
11.6.11 State the major diseases seen in the middle age.
11.6.12 Recall that coronary heart disease is one of the major causes of death in the world.
11.6.13 List the risk factors of coronary heart disease.
11.6.14 Recall that raised blood lipid levels (hyperlipidaemia), raised blood pressure (hypertension) and smoking are major contributory factors to coronary heart disease.
11.6.15 List the contributory factors to hypertension and explain the role of diet.
11.6.16 List the contributory factors to hyperlipidaemia and explain the role of diet.
11.6.17 Describe the dietary recommendations for coronary heart disease.
11.6.18 Recall that the incidence of cancer increases with age.

11.6.19 Recall that upto 80 % of cancers in humans are environmentally determined and thus are potentially preventable.
11.6.20 Explain the links between diet and cancer.
11.6.21 Recall that obesity may trigger diabetes.

11.7 Elderly

11.7.1 Recall that the term elderly is used to refer to men and women of pensionable age.
11.7.2 Explain why some of the elderly are at risk and describe how the factors may interact and increase the likelihood of a nutritional deficiency.
11.7.3 State the major contributory factors influencing a poor food intake.
11.7.4 Explain how physical, medical, social and psychological factors contribute to inadequate food intake.
11.7.5 Describe how the process of digestion and absorption could be affected in the elderly.
11.7.6 Describe how the energy and protein need of the elderly are affected in old age.
11.7.7 List the common nutritional deficiencies seen in the elderly.
11.7.8 Explain the special emphasis that should be laid when providing a balanced diet for them.
11.7.9 State the support services available in Sri Lanka for the elderly.
11.7.10 State the objectives of the support services for the elderly.

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