

(Appendix A₁)

Pre-Test

Marks : 25

Time : 30 minutes

Name: _____ Roll No.: _____

Q.1 Answer the following questions.

(a) Define the term 'food' in 2-3 lines. (1½)

(b) Specify the three main functions of foods,
each in a line or two. (1½)

i)

ii)

iii)

(c) Why foods are capable of doing these three
functions? Write your answer in three lines. (3)Q.2 Mention seven food groups with two examples of
foods in each group. (14)

i)

ii)

iii)

iv)

v)

vi)

vii)

Q.3 List all the nutrients. (5)

(Appendix A₂)

Criterion Test

Proteins

Marks : 25

Time : 45 minutes

Name: _____ Roll No.: _____

Q.1 Answer the following questions. (8)

a) What is an amino acid and why it is called so?

b) Write down and discuss its structure.

c) State the kind of amino acid against each name of the amino acid given below.

(i) Lysine

(iii) Alanine

(ii) Methionine

(iv) Tryptophane

d) Explain in brief why each kind of amino acid is called so.

e) State in short the four functions of proteins in the body.

(i)

(iii)

(ii)

(iv)

Q.2 a) Define the following - each in three lines (3)

(i) Complete proteins

(ii) Incomplete proteins

b) Write any 4 protein rich foods.

(i)

(iii)

(ii)

(iv)

Q.3 Suppose your maid servant's eight months old child, (2)
has straw coloured, straight and sparse hair. It
looks very plump, although, too light in weight and
keeps on crying and vomiting, besides which it also
passes stools number of times and is utterly listless.

From your knowledge, about these clinical features
can you say that the child is suffering from-

- a) Which nutritional deficiency disease? _____
- b) Which nutrient is deficient? _____
- c) List any two protein rich semi solid food
preparations which can help to cure the disease.
 - (i) _____
 - (ii) _____

Q.4 Fill in the blanks: (9)

- a) In a protein molecule each two amino acids are
joined by a _____ linkage.
- b) Recommended allowance of protein for man is
_____ grams and same for woman is _____
grams.
- c) When four amino acids join the resulting compound
is called a _____ and similarly when more than
seven amino acids join the resulting compound is
called _____.
- d) The meaning of the word protein is _____.
- e) One gram of protein when oxidizes in the body,
it produces _____ calories.
- f) Bajra, brinjal, apple, peas etc. are the
_____ sources of protein.
- g) The capacity of mixed plant proteins to take
care of one another's amino acids deficiencies
is known as _____ value of proteins.

Q.5 Here are a few questions. Below each questions is
given a set of three answers. Tick (✓) mark
against the most correct answer. (3)

- i) Why complete proteins are the proteins of
high biological value?
 - a) Because these are present in costly foods.
 - b) Because these help maximum growth and
optimum health.
 - c) Because these are called first class
proteins.

- ii) Which groups join, when two amino acids are linked up?
- a) NH_2 -- COOH
 - b) COOH -- COOH
 - c) NH_2 -- NH_2
- iii) What is the right age for weaning a child with protein-rich foods to help him grow well?
- a) 3 years
 - b) 13 months
 - c) 3 months
- iv) Different foods have different kinds of protein. Therefore which is the maize protein?
- a) Albumin
 - b) Zein
 - c) Gluten
- v) Who requires more protein per unit of body weight?
- a) A child
 - b) An old man
 - c) A woman
- vi) Which are the poor sources of protein?
- a) Pure ghee, butter, sugar, til oil.
 - b) Bengalgram, peas, blackgram, cashew nuts.
 - c) Bajra, apples, tomatoes, maize.
-

(Appendix A₃)

Criterion Test

Carbohydrates

Marks : 25

Time : 45 minutes

Name: _____

Roll No.: _____

Q.1 Fill in the Blanks

(4)

- a) One gram of carbohydrate on oxidation releases _____ calories.
- b) Fructose is about _____ times and Sucrose is _____ times sweeter than glucose.
- c) Recommended allowance of carbohydrates is approximately _____ grams, for an adult.
- d) Plant eating animals can digest cellulose as their digestive system consists of an enzyme called _____ which human beings do not have.
- e) The chief function of carbohydrate is to give _____.
- f) The normal blood level of glucose is _____ mgs./100 c.c. of blood.
- g) Although human beings cannot digest cellulose, it being a rough-age helps to avoid _____ by maintaining intestinal hygiene.

Q.2 Mention the name of the enzyme helping the digestion and the simple sugars, into which the following are broken down during digestion.

(5)

Sucrose -

Maltose -

Lactose -

Starch - in the mouth -

in the intestine -

- (b) State any four carbohydrates which do not undergo any digestion.

(1)

- (c) Write the three main kinds of carbohydrates in the three columns drawn below and then place the names of carbohydrates in each column, from the following list. (3)

Fructose, Maltose, Lactose, Starch, Glucose, Sucrose, Glycogen, Galactose, Cellulose.

(i) _____	(i) _____	(i) _____
(ii) _____	(ii) _____	(ii) _____
(iii) _____	(iii) _____	(iii) _____

- Q.3 (a) Suppose your 65 years old grandfather, often experiences lack of energy, goes to doctor who after examining him advises him to have his blood and urine checked up in the laboratory. On doing so, his blood level of glucose is found to be much higher than normal and his urine too, is found to contain sugar. (3)

From your knowledge about these signs, what disease do you think he is suffering from _____? What could be the two reasons which led to this disease?

(i) _____ (ii) _____

Advise him any three foods which can help him to control the disease _____.

- (b) Match only the numbers of A with B to state the correct source of each carbohydrate. (2)

(A) Carbohydrate	(B) Sources
a) Lactose	a) Cereals, root vegetables
b) Glucose	b) Honey, ripe fruits
c) Maltose	c) Sugarcane, beets
d) Fructose	d) Fruits and vegetables
e) Sucrose	e) Germinated cereals
f) Starch	f) Non-edible portions of foods
g) Cellulose	g) Muscles, liver
h) Glycogen	h) Milk

Q.4 Answer the following in very brief. (3)

- (i) What are carbohydrates composed of and what is the meaning of the term carbohydrate?
- (ii) Which are the rich sources of carbohydrates from which we get maximum energy in our daily foods?
- (iii) Explain the process and meaning of photosynthesis.

Q.5 (a) State the two common properties of the following: (2)

- (i) Glucose, fructose, Galactose - a)
b)
- (ii) Starch, glycogen, cellulose - a)
b)

(b) Write any two food sources for the following: (2)

- (i) Very rich sources of carbohydrates

- (ii) Poor sources of carbohydrates

(Appendix A₄)

Criterion Test

Fat

Marks : 25

Time : 45 minutes

Name : _____ Roll No. : _____

Q.1 Fill in the blanks

(6½)

- a) The point at which oil or fat gives off visible fumes when heated is called the _____ point.
- b) Enzyme _____ present in pancreas is necessary for digestion of fat.
- c) Fat has three molecules of fatty acids, attached to a molecule of glycerol is called _____ fat.
- d) If the fat is repeatedly heated, or if the burnt particles are not removed from the oil, once used, the smoking temperature is _____.
- e) Nuts meat eggs cream etc. are the _____ sources of fat.
- f) Cooking fats and oils contain _____ protein, carbohydrates, vitamins and minerals but _____% fat, therefore they are the _____ sources of fat.
- g) 10 gms. of fat can produce _____ calories, when oxidized in the body.
- h) The recommended allowance of fat is _____ gms.
- i) Sugar jaggery and honey are the _____ sources of fat.
- j) The two ill effects caused by the excess consumption of fat, are _____ and _____.

Q.2 Give reasons for the following:

(4)

- a) Oils are liquid but fats are solid at room temperature.
- b) Cooking oils are called vegetable oils whereas cooking fats are referred to animal fats.

c) Oils are used for deep frying whereas fats are used for shallow frying.

d) Cereals, pulses, vegetables and fruits are the fair sources of fat.

Q.3 a) Name and explain the process by which vegetable oils can be converted to ghees. Also state the two advantages of it. (1½)

b) State the 4 functions of fat in brief. (2)

c) What do you understand by rancid fats and oils. Describe the three kinds of rancidities in detail. (4)

Q.4 a) Cooking fats and oils are similar compounds. Justify the statement by discussing their chemical composition, physical properties and culinary roles. (3)

b) State 4 chief difference between shallow frying and deep frying - each in a few words. (1)

c) Explain in three lines, how fats are digested and absorbed. (1½)

- Q.5 Understand the following situation and complete the sentences given below. (1½)

Three friends participated in a cooking competition. Rama won the prize as she could fry kachories excellently. The other two friends failed, as kachories fried by Meena were burnt from outside and were raw from within, whereas those fried by Sheela were very oily, soggy and therefore not at all tasty.

This was so, because,

- (i) Sheela _____ heated the oil.
- (ii) Meena _____ heated the oil and
- (iii) Rama heated the oil just to the _____ point or to the optimum temperature.

(Appendix B₁)

Programmed Learning Material

Unit I
PROTEINS

You know that food is the prime necessity of life. Even a religious book, such as Gita, recognizes the basic saying; "of foods are beings made", i.e. all human beings are made of foods. Starting with a single cell growing to your present size and for, as long as you live, food becomes you. Food becomes your blood and bones, your brain and brow, your nose and neck, your lungs and heart, your eyes and ears; food becomes everything that you are made of. Food becomes your size and strength, your energy and stamina. Food contributes to your personality and emotional stability. In short, our existence is due to foods.

So far, you have studied about all the seven food groups, into which the foods are broadly classified. They are (1) Cereals, (2) Pulses, nuts and oil-seeds, (3) Fruits and vegetables, (4) Milk and milk-products, (5) Fats and oils, (6) Sugar, jaggery, and (7) Flesh foods.

You also know that these foods are made of NUTRIENTS. The names of nutrients are (1) PROTEINS, (2) CARBOHYDRATES, (3) FATS, (4) VITAMINS and (5) MINERALS. When we eat foods, we get nutrients. Do you know why we need nutrients? We need nutrients for many reasons, one of which is to obtain energy to work. Our body is a working machine, which has to work constantly, to exist, unlike other machines working only at intervals. Even when one is lying asleep or perfectly quiet, the heart goes on pumping the blood, the chest moves in respiration, the digestive tract is busy caring for the meals. Every movement, voluntary or involuntary, even to

winking of an eye, is a work in the mechanical sense and an exercise which brings many muscles into play, whether in digging a ditch or playing a ball, adds to the energy expended.

In order to have energy, as outlined above, we must first acquire, it. But how? The earth's great bank of energy is the Sun. Its currency is light and heat. We human beings cannot "cash in" directly. We have to go to a great clearing house, the plant world, before they become available for the human economy. Plant can make three classes of energy bearing substances known as proteins, fats and carbohydrates, which man can use for his activities. These are the "fuels" which supply energy, for the human machine. Just as train engines, motor cars, steamers receive energy from the fuels like coals, diesel, petrol etc; the human body gets ENERGY from the FUELS like PROTEINS, CARBOHYDRATES and FATS.

We will first study the fuel "Proteins". Related to Proteins, we will study the following points:

- (1) Origin and meaning of the term "protein".
- (2) Composition and building up of proteins.
- (3) Kinds of amino acids; Kind of proteins.
- (4) Supplementary value of proteins.
- (5) Food sources of proteins.
- (6) Varieties of proteins.
- (7) Recommended allowance of proteins.
- (8) Functions of proteins.
- (9) Effect of deficiency of proteins, on growing children, adults and old people.

What a tiny little infant you were, when you were just born; and how large and big adolescent girl, you have become now!! Do you know what changed you, from an infant into an adolescent? It is the nutrients, specially the PROTEINS which helped you to grow. Therefore, first of all it will be interesting to learn about the origin and meaning of the word "PROTEIN".

1. When we converse in English, we use many words which do not have their origin in English language. For example the word "Sayonara" which means "Good Bye", is not an English word, but it is a Japanese word. The word "Kinder-garten" meaning Children's Garden, is a German word; yet it is used in English, as it is. In the similar way the word PROTEIN has its origin from a Greek word PROTEOS.

You may therefore say that the term protein is derived from a word _____ which is a _____ word.

Answer : proteos, Greek

2. You have seen that "Sayonara" is a Japanese word which means "Good Bye". Similarly proteos is a Greek word which means to be first. You know that an English word for proteos is protein. Therefore protein will also have the same meaning as proteos.

Since proteos means "to be first", proteins will also mean "_____".

Answer : to be first

3. Good! Having followed the meaning of the word protein, can you guess "where proteins have to be first?" If

not, read ahead for the answer. Since protein is a nutrient naturally, it has "to be first" supplied in our "daily meals", which means that it should be present in our daily meals. But why? This is because of the reason that the chief matter of all our body organs like brain, heart, lungs, stomach, liver, small intestine, large intestine, kidneys; the nerves, blood cells, walls of the blood vessels, and the digestive tract is proteins. Even hair, nails, skin and muscles consist almost entirely of proteins. These are the major components of bones and teeth. In fact, each living body-cell and most of all the body fluids are made of chiefly proteins.

Therefore, we conclude that the whole body is chiefly made of _____.

Answer : proteins

4. Now it is clear to you that protein is the base for all the body structures mentioned above. If there would have been no proteins these structures would not have been formed; if these structures would have been not formed, the human body would not have been formed; and thus we would not have been there, on this earth. This means that our life is impossible without proteins.

Since we conclude that life is impossible without proteins, the meaning of the word protein " _____ " is rightly justified.

Answer : to be first

5. Knowing the importance of proteins in our every day meals, write only the number of the true statement from the following.
- (i) Life can exist without proteins in our daily meals.
 - (ii) Life cannot exist with proteins in our daily meals.
 - (iii) Life can exist with proteins in our daily meals.
-

Answer : (iii)

6. You have realized how important proteins are for our existence. Don't you now wonder, what proteins are formed of? Read ahead, and you will learn about the composition of proteins. Proteins are formed of compounds called AMINO ACIDS. These are the basic units for building up a protein. In other words amino acids are the building blocks of a protein.

You may therefore say that just as bricks are required to build up a wall, many _____ are required to build up a protein.

Answer : amino acids

7. Let us consider a few more examples to understand better, how a protein is built. You know that many play-cards make a pack of cards, many bogies together make a long train, many fibres weaved together result into a cloth, many students make a class;

similarly many _____ together form a _____.

Answer : amino acid, protein

8. If you have followed the above matter well, you will be able to say 'right' or 'wrong' for the following statements.

- (i) A brick is a wall
- (ii) A fibre is a cloth
- (iii) A bogie is a train
- (iv) An amino acid is a protein

Answer : wrong

9. Good! You have agreed that a single amino acid is not a protein, but many amino acids are required for building a protein. Each such amino acid that goes to form a protein is made of carbon, hydrogen, oxygen and nitrogen. Proteins are also called as nitrogenous substances because they contain nitrogen, as one of the constituents.

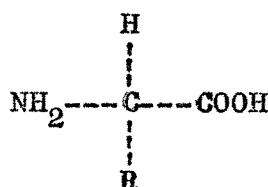
Study the facts mentioned above, thoroughly, and answer the following questions, only in a few words.

- (i) What is the basic unit of a protein?
- (ii) What are the four constituents of an amino acid?
- (iii) Why proteins are also called as nitrogenous substances?

You are right if your answers are similar in meanings to the following:

- (i) Amino acid
 - (ii) Carbon, hydrogen, oxygen and nitrogen
 - (iii) because they contain nitrogen
-

10. Very Good! Now if you look at the formula of an amino acid, which is mentioned below, you will realise the presence of C, H, O and N, which is nothing but carbon, hydrogen, oxygen and nitrogen.



An Amino Acid

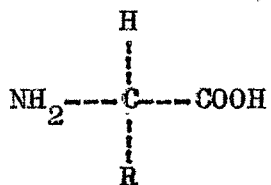
Looking at the formula, you will find that all the letters, except R, are familiar to you. R is the short form, for rest of the structures of amino acid. Besides, R is different for different amino acids. Any way, you have to only remember what CHON stand for.

Please state what each of the followings found in the amino acid formula, represent.

C = _____, H = _____, O = _____, N = _____.

Answer : Carbon, Hydrogen, Oxygen, Nitrogen

11. Good! look at the formula of an amino acid, once again, to study how four valencies of a carbon atom are satisfied.



The group present, on your left is NH₂, which is called as AMINO, group, or basic group, the group on your right is COOH group, which called carboxyl group or ACID group. On top is (H) hydrogen atom and in the bottom is R which, as you already know, stands for the rest of the structure.

Study the formula of an amino acid and say in brief:

- (a) Which is the group on your left?
 - (b) Which is the group on the top?
 - (c) Which is the group on your right?
 - (d) What is 'R'?
-

You are right if your answers are similar in meanings to the following:

- (a) NH_2 or amino group or basic group
 - (b) Hydrogen
 - (c) COOH or acid group or carboxyl group
 - (d) 'R' stands for the rest of the structure
-

12. We derive from the above fact, that it is due to the presence of one AMINO group and one ACID group, that the compound is termed as an amino acid.

Having understood the reason why an amino acid is called so, complete the following statement using suitable words.

The basic unit, amino acid, needed to build up a protein, is called so, for the reason that it has one _____.

You are right if your answer is similar in meaning to the following:

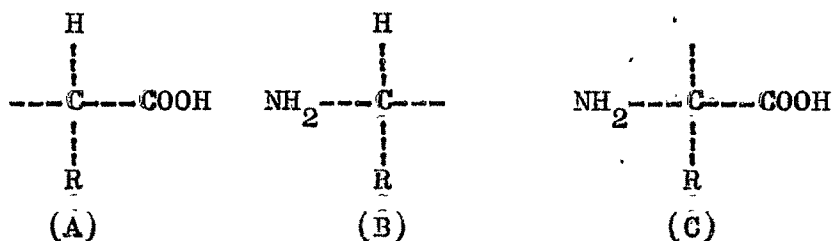
amino group and one acid group.

13. Having understood the structure of an amino acid, write the formula for the following:

- (a) An amino group = _____
 - (b) Acid group = _____
 - (c) Hydrogen atom = _____
 - (d) Rest of the structure of an amino acid = _____
-

Answer : (a) NH_2 , (b) COOH , (c) H, (d) R.

14. We have thoroughly discussed the formula of an amino acid. Here are the three sets, A, B, C of incomplete formula of amino acids. Write the missing group in each case to complete each formula.

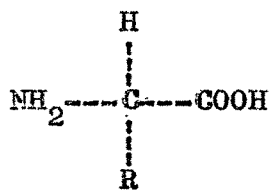


Answer : (A) NH_2 , (B) COOH , (C) H

15. Here is the memory test for you. Just try and see how much you can write at all the ends.



Answer :



16. You have noted earlier that many amino acids together are required to build a protein like many bricks together forming a wall. But just as in a wall, each two bricks are bound by cement, each two amino acids in a protein are linked by a peptide linkage.

In other words, each two amino acids are bound by a pep___ link___ in a protein molecule.

Answer : tide, age

17. Or just as a hook joint, joins each two compartments of a train _____ binds each two amino acids in a protein.

Answer : Peptide linkage

18. It is clear enough now that, peptide linkages bind amino acids together in a protein molecule. When a peptide linkage binds two amino acids into a single molecule, the resulting compound is called a di-peptide. Similarly when three, four, five and six and seven amino acids are bound together, by peptide linkages, the compounds formed are called as tri-peptide, tetra peptide, penta-peptide, hexa-peptide and hepta-peptide respectively. In this case you already know what a peptide is. What you need to understand, are the meanings of pre-fixes which are written before the word peptide. The meanings are as follows:

Di = two, Tri = three, Tetra = four, Penta = five, Hexa = six, and Hepta = seven.

Study all the spellings and meanings thoroughly and then only proceed further to complete the following statements.

- (a) When three amino acids join together by peptide linkages, the resulting compound is called a _____.
- (b) A compound having five linked amino acids is called a _____.
- (c) A compound having four amino acids is called a _____.
- (d) Compounds consisting of six and seven amino acids linked together are called as _____ and _____ respectively.

Answer : (a) tri-peptide; (b) penta-peptide; (c) tetra-peptide
(d) hexa-peptide, hepta-peptide.

19. Here are the names of different peptides you studied in previous frame. Complete the table by writing the number of amino acids in the blank column.

Sr. No.	Name of the Compound	Number of amino acids
a.	Tetra peptide	
b.	Hexa-peptide	
c.	Tri-peptide	
d.	Di-peptide	
e.	Penta-peptide	
f.	Hepta-peptide	

Answer : 4, 6, 3, 2, 5, 7

20. You are right. Similarly when more than seven amino acids join together a compound formed is a polypeptide. Poly means many, a large collection of polypeptides then form a complex protein.

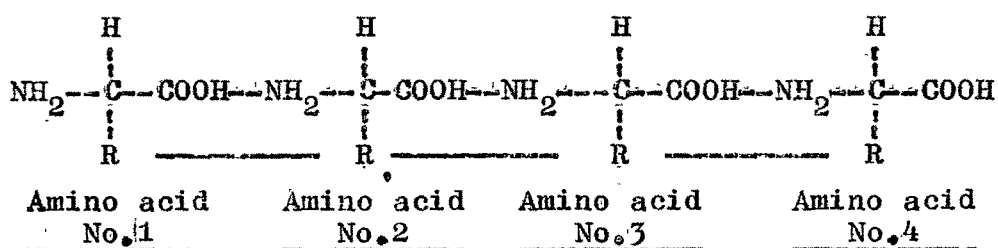
With this information state whether the following statements are true or false.

- i) A compound consisting of eight amino acids is a poly-peptide.
- ii) A poly-peptide is a compound having less than seven amino acids.
- iii) A complex protein is formed, when many polypeptides are united by peptide linkages.
- iv) A compound consisting of more than seven amino acids is a poly-peptide.

Answer : (i) True, (ii) False, (iii) True, (iv) True.

21. Very Good! Now you are ready to proceed further. You have followed that amino acids join to form a protein. Therefore, now let us get acquainted with, how exactly

amino acids join to form a protein. To understand it better, look at the chain of four amino acids joined below.

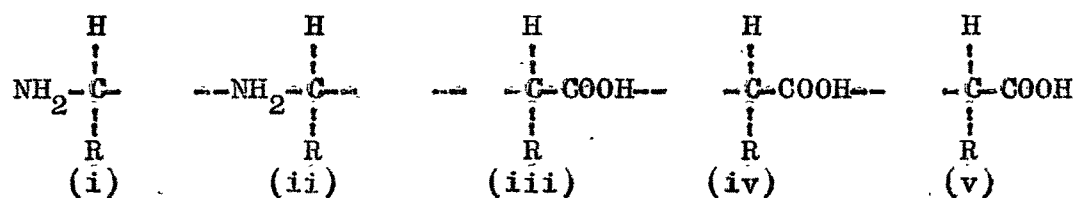


First notice the underlined groups of amino acid, No.1 and 2, those of amino acid No.2 and 3, and the same of amino acid No.3 and 4. You can very well recognize these groups. Can't you? You can say that COOH group of amino acid No.1 joins with NH₂ group of the amino acid No.2, COOH group of amino acid No.2 joins the NH₂ group of amino acid No.3 and similarly it continues for amino acid No.3 and 4. You can therefore, say that, two similar groups of each two amino acids never join to form a protein.

In other words, we can conclude that a peptide linkage binds two _____ (like/unlike) groups of each two amino acids.

Answer : unlike

22. Here below are given 5 amino acids. Please join these correctly to form a complete chain, by writing the missing group in each amino acid. Write the missing group of each amino acid with the number of amino acid.



Answer : (i) COOH, (ii) COOH, (iii) NH₂, (iv) NH₂, (v) NH₂

23. Having realized how the amino acids join to form a protein, point out the number of the true statements in the following.

- (a) NH_2 group of one amino acid joins the COOH of the other amino acid.
- (b) COOH group of one amino acid joins the NH_2 of the other amino acid.
- (c) COOH group of one amino acid joins the COOH group of the other amino acid.

Answer : (a), (b)

24. Here is an illustration to understand the joining process of the amino acids. Read and react if you can. Here below are the two necklaces.

(A)

(B)

Both necklaces are made of similar shape of beads i.e. Yet they look different. Why? They look different because the beads have been joined differently. In case of necklace A, two dissimilar sides of beads join, whereas in case of necklace B, similar sides of beads join.

Can you say, the beads of which necklace join like the amino acids join, to form a protein? It is of the necklace ____.

Answer : 'A'

25. So far you have gathered enough information about amino acids, but yet, one important point you need to understand, is the kinds of amino acids. There are two kinds of amino acids, namely, (1) the essential amino acids and (2) the non-essential amino acids. Essential amino acids are 10 in number and non-essential amino acids are many but we will study a few names of non-essential

amino acids also. First let us study the 10 names of essential amino acids. They are as under.

- | | |
|------------------|--------------------|
| (1) Leucine; | (6) Isoleucine; |
| (2) Lysine; | (7) Methionine; |
| (3) Tryptophane; | (8) Phenylalanine; |
| (4) Threonine; | (9) Arginine; |
| (5) Valine; | (10) Histidine. |

Reading through these names, you must have realized that these sound very strange to you. But here is the easy way of memorizing these names. First remember only the beginning alphabet of each name as indicated set-wise below.

- | | | | | | |
|-------|---------|-------|---------|--------|---------|
| (1) L | } Set 1 | (5) V | } Set 3 | (9) A | } Set 4 |
| (2) L | | (6) I | | (10) N | |
| (3) T | } Set 2 | (7) M | } | | |
| (4) T | | (8) P | | | |

Repeat these sets several times in the order mentioned, till you remember thoroughly. After this, repeat the full names of essential amino acids, only in sets. When you are certain that you know all the names perfectly then only proceed further.

26. Well, now complete these names in the following sentences:

- The amino acids in the first set are Leu____ and Ly_____.
- The amino acids in the second set are Try_____ and Threo_____.
- The amino acids in the third set are, Val____, Iso_____, Methi_____ and Phenyl_____.
- The amino acids in the fourth set are Argi_____ and His_____.

Answer : (a) cine, sine, (b) ptophane, nine, (c) ine, leucine, onine, alanine, (d) nine, tidine.

27. By now you must have remembered all 10 names of essential amino acids. Recall these from their first alphabet, as given below and complete the table.

Sr. No.	The first alphabet	The full names of the essential amino acids
i	L	
ii	L	
iii	T	
iv	T	
v	V	
vi	I	
vii	M	
viii	P	
ix	A	
x	H	

Answer : (i) Leucine; (ii) Lysine; (iii) Tryptophane; (iv) Threonine; (v) Valine; (vi) Isoleucine; (vii) Methionine; (viii) Phenylalanine; (ix) Arginine; (x) Histidine.

28. Now you have had enough practice for memorizing all ten names of essential amino acids. Write out all ten names here below:

(1)	(2)	(3)	(4)	(5)
(6)	(7)	(8)	(9)	(10)

Answer : (1) Leucine, (2) Lysine, (3) Tryptophane, (4) Threonine, (5) Valine, (6) Isoleucine, (7) Methionine, (8) Phenylalanine, (9) Arginine, (10) Histidine.

29. So far you studied the ten names of essential amino acids, now learn the five names of non-essential amino acids. They are as under:

- (1) Glutamic acid; (2) Aspartic acid; (3) Alanine;
(4) Proline; (5) Hydroxy proline.

Repeat each name several times till you remember thoroughly.

30. To test your memory, complete the names of non-essential amino acids given below:

- (i) Glu_____ Acid; (ii) Aspar_____ acid; (iii) Ala_____;
(iv) Pro____e; (v) Hydro_____.

Answer : (i) tamic; (ii) tic; (iii) nine; (iv) lin;
(v) xy proline.

31. Ofcourse by now you must be confident about all the five names of non-essential amino acids. Try to write out these names fully.

- (i) _____; (ii) _____; (iii) _____;
(iv) _____; (v) _____.

Answer : The order may differ : (i) Glutamic acid;
(ii) Aspartic acid; (iii) Alanine; (iv) Proline;
(v) Hydroxy proline.

32. Certainly now, you very well know the names of essential and non-essential amino acids. Below are the names of both the kinds of amino acids. Put 'E' against the names of essential amino acids, and 'NON' against the names of non-essential amino acids against each name.

- | | |
|-------------------|----------------|
| (a) Phenylalanine | (d) Proline |
| (b) Histidine | (e) Methionine |
| (c) Glutamic acid | (f) Alanine |

Answer : (a) E, (b) E, (c) NON, (d) Non, (e) E, (f) NON

33. Knowing the kinds of amino acids, arn't you eager to know why some amino acids are called essential ones and others as non-essential ones? Read the following passage which explains the same.

"To be healthy, essential amino acids, should be present in our daily meals because these are not synthesized or formed in our body, while non-essential amino acids are synthesized in our body, and their presence in the diet is not so essential. However, essential and non-essential, both kinds of amino acids are essential for our body.

In simpler terms, you can say that the amino acids which are not synthesized in the body and therefore which have to be present in our daily diets are called the _____; and the amino acids which are synthesized in our body and therefore may or may not be present in our daily diets are _____

Answer: essential amino acids, non-essential amino acids.

34. (A) Having understood the reason why each kind of amino acid is called so, write the missing part in the sentences given below.

(i) Some amino acids are termed as essential amino acids because _____

(ii) Some amino acids are called non-essential amino acids because _____

(B) You have learnt both the kinds of amino acids.

Isn't it? Now tick (✓) mark against those names of amino acids which should be present in our daily diets.

(i) Isolencine

(v) Lysine

(ii) Aspartic

(vi) Proline

(iii) Valine

(vii) Alanine

(iv) Methionine

(viii) Threonine

Answer : You are right if your answers are similar in meaning to the following:

- (A) (i) because to be healthy these have to be essentially present in daily foods.
- (ii) these may or may not be present in our daily meals to keep us healthy.

(B) (i) , (iii) , (iv) , (v) , (viii) .

35. Since essential amino acids should be present in our daily foods you should know, which foods contain proteins formed of almost all the essential amino acids. In short proteins of all the animal foods are the rich sources of essential amino acids. On the other hand, proteins of foods are deficient in essential amino acids. A very important point to learn in the context here, is that, the proteins of animal foods are called the "complete proteins" as these are composed of all the essential amino acids in the right quantity as needed by a normal healthy body, whereas the proteins of plant foods are called the 'incomplete proteins' because these do not contain all the essential amino acids. Incomplete proteins lack in one or many amino acids.

Read the above information thoroughly and answer the following questions.

I. Complete the following statements to define 'complete' and incomplete proteins.

a) Complete proteins are those proteins which contain all

b) Incomplete proteins are those proteins which

II. Write only the numbers of the food which contain complete protein.

- | | |
|----------------|----------------|
| (i) Meat | (v) Rice |
| (ii) Fish | (vi) Eggs |
| (iii) Tomatoes | (vii) Grapes |
| (iv) Apple | (viii) Cabbage |

Answer : I. (a) the essential amino acids in the right quantity as needed by the normal healthy person.

(b) do not contain all the essential amino acids.

II. (i), (ii), (vi).

36. Complete proteins present in non-vegetarian foods are called the first class proteins or the proteins of high biological value or the good quality proteins, because these are digested easily and utilized best by our body; and due to this, they support maximum growth and maintain optimum health.

Learning the above fact answer the following questions, each in a line.

- (a) What are the complete proteins also known as?
- (b) Why complete proteins are capable of supporting maximum growth and maintaining optimum health?

Answer : (a) Complete proteins are also called first class proteins or proteins of high biological value, or the good quality proteins.

(b) It is so because complete proteins can be digested easily and utilized well by our body.

37. Here below are a few points from the information you had for complete proteins. Form a sentence out of each point.

- (1) COMPLETE = I CLASS = HIGH BIOLOGICAL VALUE = good quality
- (2) Amino acids composition of complete protein
- (3) Food source of complete protein
- (4) Function of complete protein

You are right if your answer is similar in meaning to the following:

- (1) Complete proteins are also called the first class proteins or proteins of high biological value or the good quality proteins.
 - (2) These are made of essential amino acids.
 - (3) These proteins are obtained from animal foods.
 - (4) These help maximum growth and optimum health.
-

38. Complete proteins present in the plant foods cannot be digested and utilized so well as the complete proteins, thus these alone cannot support good growth and cannot maintain good health.

These are therefore the proteins of ____ (high/low) biological value.

Answer : low

39. From the knowledge, you have, concerning the two kinds of proteins (i) complete and (ii) incomplete proteins; considering the following points, state the four chief differences between these two kinds of proteins.

- i) Essential amino acids content
- ii) Food sources
- iii) Biological value
- iv) Supporting growth and health.

	<u>Complete proteins</u>	<u>Incomplete proteins</u>
i)	_____	_____
ii)	_____	_____
iii)	_____	_____
iv)	_____	_____

You are right if, your answer is similar in meanings to the following:

<u>Complete proteins</u>	<u>Incomplete proteins</u>
i) Contain all the essential amino acids in adequate amounts.	i) Deficient in one or many amino acids.
ii) Animal foods contain these.	ii) Plant foods contain these.
iii) High biological value	iii) Low biological value.
iv) Support maximum growth and maintain good health.	iv) Do not support good growth or maintain health.

40. You have now gathered that incomplete proteins do not support good growth and do not maintain optimum health. Therefore you will agree that all must eat foods containing complete proteins. But complete proteins are found in animal foods and all people are not non-vegetarians. Besides this, animal foods like eggs, fish, meat etc. are very costly compared to plant foods like, cereals, pulses, vegetables etc. Therefore all people will not be able to afford animal foods daily. Well, this does not mean that vegetarian people are not healthy or the people who cannot afford animal foods, are unhealthy. The fact that some vegetarians get along quite well, suggests that all the essential amino acids can be made available to man, from plant foods alone.

This suggest that from vegetarian diet also, one can get _____ (complete/incomplete) proteins.

Answer : complete

41. But how this is possible? Read further to learn, how, from plant foods, or vegetarian foods alone, all the essential amino acids could be obtained. You have observed that the proteins of plant foods are incomplete proteins, not having all the essential amino acids, but lack in one or more essential amino acids. It is important to note that proteins from two or more plant foods, if combined judiciously, these can make up, each others' amino acids deficiencies. For example, cereals lack in an essential amino acid lysine, but have methionine, pulses are deficient in an essential amino acid methionine but are rich in lysine. Thus we can expect a combination of cereal and pulse, to be more nutritive than a cereal or a pulse, alone.

Study the above matter thoroughly and answer the following questions in short.

- (i) Which essential amino acid, cereals lack in?
- (ii) Which essential amino acid pulses are deficient in?
- (iii) Which essential amino acid cereals have, which pulses lack in?
- (iv) Which essential amino acid pulses have, which cereals are deficient in?
- (v) What would be more nutritive?
 - (a) A food cooked out of only one cereal.
 - (b) A food cooked out of only one pulse, or
 - (c) A food cooked out of a mixture of cereal and pulse?

Answer : (i) Lysine, (ii) Methionine, (iii) Methionine, (iv) Lysine, (v) c.

42. To understand the fact that plant protein mixtures are more nutritive, than a single plant protein, go through the table, showing the results of the small laboratory, animal experiment; mentioned below.

Weight gain of rats fed on different diets:

Experiment	Rat	DIET	Weight gain in four weeks (Gms.)
I	No.1	Wheat	19
	No.2	Wheat + Bengal gram	31
II	No.3	Kodri	10
	No.4	Kodri + Peas	39

N.B.: Foods and protein intake was the same in the different groups in each experiment.

The table includes two experiments in which two rats of the same age and weight, born to same mother-rat were used in each experiment. In Expl. I, one rat was fed only one cereal diet i.e. wheat, whereas the other rat was fed on a diet containing cereal pulse mixture, i.e. wheat + bengalgram. Similarly in Expl. II one rat was fed only a cereal diet i.e. Kodri and the other rat was fed on a diet containing a cereal pulse combination i.e. Kodri + peas. Note the weight-gain in each experiment when two different diets were fed for four weeks.

It can be thus noted from the results of the study that cereal pulse mixtures are _____ nutritive compared to only a cereal fed; since a single plant protein is an _____ (complete/incomplete) protein.

Answer : more, incomplete

43. In this connection we may note that if the protein of the diet is deficient in one or more of the essential amino acids, and if another protein containing the missing amino acid is added to the diet, the nutritive

value can be enhanced. This capacity of the proteins to make good one another's deficiencies is known as their supplementary value of proteins.

Read the above paragraph and answer the following questions in brief.

- (i) What do you understand by supplementary value of proteins?
- (ii) Does supplementary value help to increase the nutritive value of the mixture?

Answer : (i) Mixing of two incomplete proteins in such a way that one another's deficiencies are made up and a complete protein is formed.

(ii) Yes.

44. From the above discussion we draw a conclusion that _____ value of protein is important to improve the quality of proteins, or supplemented plant proteins are more nutritive.

Answer : Supplementary

45. You know that supplemented foods are more nutritive, since these have the improved quality of proteins.

Can you now state, which of the following recipes have complete proteins and thus are more nutritive?

- (i) Idlies, (ii) Bengalgram sev, (iii) Puran poli,
 - (iv) Puri, (v) Khichdi, (vi) Rice.
-

Answer : (i) Idlies, (iii) Puran poli, (v) Khichdi.

46. You have noted that cereals lack in lysine, whereas pulses are deficient in methionine. Therefore, the incomplete plant proteins need to be supplemented to improve the quality of protein. On the other hand, the animal foods having complete proteins in which all

the essential amino acids are present need not be supplemented.

Bearing the above fact in mind, state whether following statements are true or false.

- (i) Eggs can be eaten alone without supplementation.
- (ii) Quality of protein is better in plant protein, mixtures, than that in individual plant food.
- (iii) Meat should be supplemented before eating, to have improved protein.
- (iv) It is better to eat Khichdi than to eat rice alone, as the quality is better in former than in later.

Answer : (i) True, (ii) True, (iii) False, (iv) True.

47. The non-vegetarian foods which need no supplementation to improve the quality of proteins are considered to be RICH sources of proteins.

To be more precise animal foods like eggs, meat, fish, liver, poultry, milk and milk products which contain complete proteins needing no supplementation are the _____ sources of proteins.

Answer : rich

48. Contrary to this, the vegetarian foods which need supplementation to improve the quality of protein are considered as FAIR sources of proteins.

Obviously then the plant foods like cereals, pulses, nuts and oil seeds, fruits and vegetables, containing incomplete proteins, and thus, needing supplementation are the _____ sources of proteins.

Answer : fair

49. It is very important to note in this connection that out of all the plant foods, mentioned earlier, quantity of protein, in most of the pulses, nuts and oil-seeds is same or even more than that present in the rich sources of proteins, i.e. the non-vegetarian foods. In spite of this, pulses, nuts and oil-seeds are not considered as the rich sources of protein, because as you studied earlier these contain incomplete proteins and hence are considered inferior, quality-wise.

Read the above points with concentration and answer the following questions by writing only 'yes' or 'No' against each question.

- (a) Do green gram, pistachionut and groundnut, contain more proteins, compared to eggs, milk, meat, etc?
- (b) Is it correct, that pulses, nuts, oil seeds etc. being plant foods contain incomplete proteins?
- (c) Do animal-foods contain complete proteins?
- (d) Are non-vegetarian foods, superior to pulses, nuts, and oil-seeds in terms of quality of proteins?
- (e) Do you, then, agree that since pulses, nuts and oil-seeds are inferior in protein-quality, compared to egg meat fish, they cannot be termed as rich sources of protein.

Answer : (a) Yes, (b) Yes, (c) Yes, (d) Yes, (e) Yes.

50. So it can be concluded that non-vegetarian foods are the _____ sources of protein whereas vegetarian foods are the _____ sources of proteins.

Answer : rich, fair

51. Apart from the foods containing more or less quantity and quality of proteins, there are foods which do not contain any protein. Such foods are referred to as

POOR sources of protein. The examples are (a) Sugar, (b) Jaggery, (c) Cooking oils and (d) Cooking fats.

Now try to fill in gaps with the correct word.

(a) Just as a man having no money is called a poor man, similarly foods having no protein are referred to as the _____ sources of protein.

(b) The examples of poor sources of protein are chiefly four: They are (a) _____, (b) _____, (c) _____ and (d) _____.

Answer : (a) Poor

(b) The order may differ. (a) Sugar, (b) Jaggery, (c) Cooking fats, and (d) Cooking oils.

52. Good! So in all, we discussed three kinds of food sources of proteins. They are : (1) _____, (2) _____, and (3) _____ sources of proteins.

Answer : The order may differ (1) Rich, (2) Fair, (3) Poor.

53. Herebelow is the list of different foods which can be catagorized as rich, fair and poor sources of protein. Write 'R' if the source is rich in protein content 'F' if the source is fair in protein content and 'P' if the source is Poor in protein content, against each names.

- | | | |
|----------|------------------|----------------|
| 1. Mango | 5. Bajra | 9. Eggs |
| 2. Meat | 6. Rice | 10. Dalda |
| 3. Sugar | 7. Green peas | 11. Fish |
| 4. Liver | 8. Groundnut oil | 12. Groundnuts |

Answer : 1. F, 2. R, 3. P, 4. R, 5. F, 6. F, 7. F, 8. P, 9. R, 10. P, 11. R, and 12. F.

If you are interested to know about the exact quantity of protein in all the foods, read pages 60 to 114 of "Nutritive Value of Indian Foods" by C. Gopalan, National Institute of Nutrition, ICMR, Hyderabad, India, 1974.

Now we will go to the Food-laboratory for the laboratory demonstration.

54. You have observed that most of the foods contain more or less protein. The proteins from different sources are not alike. Eg. the protein in milk differ from protein in wheat because the number and kinds of amino acids used, to make up these proteins are not the same. The proteins in the body also, vary widely for the same reason and therefore the protein of liver is unlike that of the muscles. Thus the proteins belonging to the different sources have different NAMES. The following are the few names of proteins of different foods, having different names.

Sr. No.	Food Source	Name of the protein
1.	Wheat	Gluten
2.	Maize	Zein
3.	Milk	Casein
4.	Meat	Myosin
5.	Egg	Albumin
6.	Pulse	Legumins

Rearrange the following letters to form the correct names of proteins for the foods listed.

Sr. No.	Food Source	Name of the protein
1.	Milk	CSEINIA
2.	Meat	MOYISN
3.	Egg	ABULMIN
4.	Pulse	LEMINGUS
5.	Maize	ZINE
6.	Wheat	GLUENT

Answer : (1) CASEIN, (2) MYOSIN, (3) ALBUMIN, (4) LEGUMINS, (5) ZEIN, (6) GLUTEN.

55. Good!. You know thoroughly the names of proteins in different foods. Try to complete the following table with the missing names of either foods or that of the proteins.

Sr.No.	FOODS	PROTEINS
(a)	Maize	_____
(b)	Egg	_____
(c)	_____	Gluten
(d)	_____	Myosin
(e)	Milk	_____
(f)	Pulse	_____

Answer : (a) Zein, (b) Albumin, (c) Wheat, (d) Meat,
(e) Casein, (f) Legumins.

56. Because foods vary in their protein quality and quantity; and because individuals may also differ in their actual protein needs, the Recommended Allowance i.e. the daily requirements, of proteins is different, for old and young, man and woman, adolescents and children etc. In short, you can also say that the recommended allowance is different for different individuals. Perhaps you do not know why the protein needs, vary, for different people. Don't worry. Read further and you will understand the reason. Protein needs vary for different individuals because they vary in Age and Sex.

In other words, _____ and _____ are the two factors which decide the recommended allowance of protein; for an individual.

Answer : the order may differ :
Age, Sex

To know more about the recommended allowance for different individuals, read page 27 of "Nutritive Value of Indian Foods", by C. Gopalan, B.V. Rama Sastri, D.C. Balsubramanian, National Institute of Nutrition, ICMR, Hyderabad, India, 1974.

57. Let us consider a few examples of daily requirement of protein by different individuals from the same book mentioned above.

Group	Particulars	Protein requirement/day (Gms)
Man	Both of the same age and doing moderate work	55
Woman		45
Child	Seven years old	33

As per the table above, a man requires more protein than a woman of the same age, doing same kind of work because of the difference in ____; and a child, only seven years old requires much more amount of protein for his age, compared to man and woman, because of the difference in ____; as he has to grow.

Answer : Sex, age

58. Therefore, you can conclude that (i) a ____ (man/woman) requires more protein than ____ (man/woman); and (ii) Younger the individual ____ (higher/lower) is the protein requirement.

Answer : man, woman, higher

59. Arn't you now curious to know, why we require proteins daily? The answer is, we require proteins daily because proteins are needed to carry out many important functions in our body. The first function is to help the growth. Amino acids of the proteins are used as building blocks to construct new body tissues throughout the

entire growth period; from the very beginning of life to complete the adult development.

It is obvious then, that protein must be generously supplied in the diet of a child during the entire _____ period.

Answer : growth

60. From your knowledge, interpret the following diagram in one sentence:

: Brick :	: Brick :	: Brick :		: Amino :	: Amino :	: Amino :	
: : :	: : :	: : :		: acid :	: acid :	: acid :	
Brick :	Brick :	Brick :	Brick :	Amino :	Amino :	Amino :	Amino :
: : :	: : :	: : :	: : :	acid :	acid :	acid :	acid :
: Brick :	: Brick :	: Brick :		: Amino :	: Amino :	: Amino :	
: : :	: : :	: : :		: acid :	: acid :	: acid :	

You are right if your answer is similar in meaning to the following:

Bricks are added to a wall being built and amino acids are added to a tissue, being built, or the same can be also interpreted as:

"In the same way as new bricks are added when the house is being built, so are new proteins formed and added to the body structure, throughout the process of growth."

61. You already know that protein is necessary for growth, particularly the complete proteins support good growth. Foods like eggs, meat, fish, milk and milk products, containing complete proteins as they support good growth, and help to build the body, can also be called as good body building food.

Thus do you agree that chiefly, foods containing complete proteins, since they are good body building proteins, should be given to a growing child? (Yes/No)

Answer : Yes

62. As you know protein since it helps to build the body, is very essential for the growth. But this does not mean that no protein is required after the growth is completed. Protein is required even after the growth is completed to maintain the body tissues, as these wear out and need to be replaced, or repaired.

Just as the old house requires maintenance, to look sound, so we adults also require to _____ our body tissues to appear healthy.

Answer : maintain

63. Besides helping the growth and maintaining the body tissues, the third function of the protein is to make in our body, many other compounds of tremendous importance to our health. These compounds are (i) Haemoglobin (ii) Enzymes (iii) Hormones and (iv) Antibodies.

You are definitely familiar with all these names of the compounds which are made of proteins. Next will study about each compound in brief.

-
64. Haemoglobin which is present in red blood corpuscles is made of the combination of two nutrients, 'Heam' and 'Globin'. 'Heam' means iron and 'Globin' is a protein.

Does Haemoglobin contain protein? (Yes/No)

Answer : Yes

65. You know that rail-road trains have special cars having tankers or big cylinders to carry gasoline.

The blood, in the same way has its special carriers called red blood corpuscles, containing _____ which is formed of iron and _____, to deliver oxygen to the whole body cells; thus helping the respiration of all body cells.

Answer : Haemoglobin, protein

66. The Enzymes which help metabolic reactions in the body are also made of proteins.

Besides haemoglobin, which other compounds are made of protein?

Answer : The enzymes

67. In addition to haemoglobin and enzymes, the third kind of compounds called HORMONES which regulate our body functions, are, too formed of proteins.

Or the compounds called _____ which regulate our body functions are also made of proteins.

Answer : hormones

68. Besides haemoglobin, enzymes, and hormones, proteins also form Anti-bodies which are found in blood. The function of anti-bodies is to protect the body by combining with bacteria or poison, which reaches the blood, and to destroy the same. The anti-bodies are often compared with soldiers, because they fight against the harmful germs that enter the body; and try to destroy them. In this battle, if the anti-bodies, win, the body is saved from the infection or disease. But if these, lose the battle, the person gets infection or the disease. Suppose you fall down, and thus a cut is formed on your knee. The germs will enter the body, through the same wound or cut on the knee. If you are healthy enough and you have plenty of anti-bodies to fight against the germs, your wound will be healed up quickly.

So how healthy you are depends mainly on how healthy and strong your _____ are.

Answer : anti-bodies

69. We thus summarize that the four body compounds, made of proteins, namely, (a) _____, (b) _____ (c) _____, and (d) _____ are of tremendous importance to our health.

Answer : The order may differ : (a) Haemoglobin, (b) Enzymes, (c) Hormones, (d) Anti-bodies.

70. Besides these three functions, proteins, also give energy to the body. To understand why it is capable of giving energy; first answer the following questions; selecting a right word or phrase from the bracket given against each question.

- (i) What gives energy to a motor-car to run? (petrol/ water)
- (ii) How does petrol give energy to a motor-car? (by burning/by remaining as it is)
- (iii) What is produced when petrol burns? (heat/light)
- (iv) What is petrol, since it burns and produces heat? (non-burning substance/a fuel)

Answer : (i) petrol, (ii) by burning, (iii) heat, (iv) a fuel.

71. Just as petrol is a fuel for a motor car as it burns to give heat or energy, protein is also a _____ for human body as it also oxidizes or burns to give heat or _____ to our body.

Answer : fuel, energy

72. Fuel value or energy value of protein is measured in terms of calories, i.e. in other words, to say that "energy is obtained from protein", we can also say that calories are obtained from proteins.

Do you then, agree that fuel value or energy value of protein, is the same as calorific value of protein?

Answer : yes

73. It is clear to you that energy and calories are the same. But perhaps, you do not know what an energy or a 'CALORIE' is. Read further and you will get an answer to this.

A calorie is the 'amount of heat' required to raise the temperature of one kilogram of water through one degree centigrade.

Read the above sentence and complete the following statements.

- (i) A calorie is the certain amount of _____.
- (ii) This heat can raise the _____.
- (iii) The temperature of _____ kilogram of water can be raised.
- (iv) The temperature of one kilogram of water can be raised to _____ ° C.

Answer : (i) heat, (ii) temperature, (iii) one, (iv) 1

74. After understanding the above fact, we can conclude in short that energy or a calorie is 'the certain amount of heat'. Let us now realize that one calorie is equal to exactly how much of heat. To understand the same, follow the experiment given below:

Take a container, pour one kilogram of water into it. Note its temperature using a thermometer. Suppose the original temperature is 15°C. Heat the same water till the temperature reaches 16°C. Whatever heat has been evolved for raising the temperature of 1 Kg. of water, from 15°C to 16°C, is one calorie.

Now try and complete the following definition of a calorie.

A calorie is the amount of heat required to raise

Answer : You are right if your answer is similar in the mean to the following : the temperature of one kilogram of water to one degree centigrade.

75. Correct! You now know that protein is a fuel which burns in the body to supply energy or calories. To be exact, one gram of protein, when burns (oxidizes) in the body, produces heat which is equal to 4 calories.

How many calories are obtained when one gram of protein oxidizes in the body?

Answer : 4 calories

76. Since one calorie is equal to the amount of heat required to raise the temperature of one kilogram of water to 1°C , 4 calories produced by burning or oxidation of one gram of protein, in the body, would be equal to, the amount of heat, which can raise the temperature of one kilogram of water to ___ centigrade.
-

Answer : 4°

77. Fill in the following gaps with the correct word or figure:
- (a) Heat or energy or _____ can be produced when proteins are oxidised in the body.
 - (b) A calorie is the amount of _____ required to raise the temperature of _____ kilogram of water to _____ centigrade.
 - (c) One gram of protein gives _____ calories, when oxidized in the body.
-

Answer : (a) Calories, (b) heat, one, 1° , (c) 4

78. Recall and write down, all the four functions, each in a few words.
- (i)
 - (ii)

(iii)

(iv)

Answer : (i) Protein promotes growth, (ii) Protein helps to maintain the body tissues, (iii) Proteins form haemoglobin, hormones, enzymes and anti-bodies, (iv) Proteins give, heat or calories or energy to our body.

79. Learning the important functions of proteins, you must have realized that proteins are needed by all; growing children, adults and old people. If such a valuable nutrient protein, lacks in daily diets, then all would suffer from the effects of protein deficiency. Isn't it? Let us, first concentrate on how growing children suffer if their daily diets are deficient in proteins. You already know that proteins support growth, thus growing children should be given enough quantity and good quality of protein rich foods in their daily meals, right from the age of three months. But you will wonder that 'three months' is too small an age, when a child can hardly take any other food except milk. This is a false concept. If protein rich foods are given in the form of semi solid preparations, a small child can eat and digest these.

Do you now agree that preparations like soups of meat, vegetables and pulses; a mixture of mashed fruits and curds, any nut-powder paste, half boiled eggs, puddings, etc. can be fed to a child right from the age of three months to encourage its growth? (Yes/No).

Answer : Yes

80. The time or period during which a child should be given semi-solid foods along with milk, is called the weaning period. As stated earlier weaning period begins at the age of three months.

Understand the above fact and state the number of the true statement from the following:

- (i) Weaning period is that period during which a child also receives solid goods alongwith liquid food like milk.
- (ii) Weaning period is that period during which a child's daily diets include semi-solid foods, along with the milk.

Answer : (ii)

81. The semi solid weaning diets used daily for a child, must have some of the previously stated protein rich foods, to help a good growth. If the weaning diets of a growing child lacks in protein-rich foods, during the weaning period he suffers from a protein deficiency disease, called KWASHORKOR.

In other words, Kwa_____ is the name of deficiency disease, a weaning child suffers from, if his daily diets are poor in protein-rich foods.

Answer : shiorkor

82. Or to protect a growing child against the protein deficiency disease called _____, it should be given enough quantity of semi-solid protein rich food during the whole _____ period which starts at the age of _____ months.

Answer : Kwashiorkor, weaning, three

83. Very Good! Thus the cause of the disease, kwashiorkor can be briefly stated as "Deficiency of protein in daily diets of a growing child, during the weaning period". Isn't it right? Now let us understand why a child is not given protein bearing necessary foods, when it should be given. The reasons are (i) Poverty and

(ii) Ignorance about nutrition. Either people have no money to afford protein rich costly foods, or people, even though, they can afford to purchase protein rich foods, have no knowledge of nutrition. Some rich people wrongly believe that even semi-solid preparations made out of pulses, nuts and non-vegetarian foods are very difficult to digest for the growing children. Consequently, rice, sago, potato, yam, bananas, and other sweet preparations containing a lot of sugar and jaggery which are carbohydrates rich foods, are only used as weaning foods. These are definitely low in protein content. The sole use of such low protein foods for growing children leads to the disease Kwashiorkor.

Study the above paragraph and join the number of BEGINNINGS with that of suitable ENDINGS to make sensible sentences.

BEGINNINGS:

- (i) The two factors responsible for causing Kwashiorkor
- (ii) It is not correct to believe that semi-solid preparations made out of green grams, cashew-nuts, eggs, fish, etc.
- (iii) It is a wrong practice to use only cereals root vegetables, sugar and jaggery

ENDINGS:

- (i) are not easily digested by growing children.
- (ii) as weaning foods, since these fail to supply enough quantity and quality of proteins.
- (iii) are poverty and ignorance about nutrition.

Answer : (i) (iii), (ii) (i), (iii) (ii)

84. Knowing the cause of the disease, it is important to note the CLINICAL FEATURES of the disease Kwashiorkor. This refers to the external signs on the body from which the particular disease can be recognized. To give you a simple familiar example, suppose on touching the body of a person feeling uneasy you find that the body is quite hot. What conclusion will you draw from this? Definitely you will say that the person has fever. Thus the 'hot body' of a person, not at ease, is the external sign of clinical feature from which you make out that person suffers from fever. There are many clinical features from which you can make out that a child suffers from Kwashiorkor. The first clinical feature or the external sign of Kwashiorkor is failure to grow because of lack of protein in his daily meals. Even though the child fails to grow, it looks plump and well fed, because the water collects in the tissues, in the place of protein. This condition is called "Oedema", which is the second clinical feature of the disease.

Study the two external signs of kwashiorkor and say either 'yes' or 'no' for the following statements.

- (a) If the weight of a kwashiorkor child is recorded at certain intervals, he can be found, losing his weight gradually.
- (b) A kwashior child may look fat and plump because of oedema.

Answer : (a) yes, (b) yes

85. The third clinical feature of kwashiorkor is (i) the hair becomes lusterless, straight, soft and sparse; (ii) the black colour of the hair turns either grey, brown or light yellow. These changes are again because of the fact that hair is made of protein.

Is it right to say that the texture and colour, both of hair are changed, when a child suffers from Kwashiorkor? (Yes/No) _____.

Answer : Yes

86. O.K. Now mention the changes in hair, in terms of the following in case of a Kwashiorkor child.

- (i) Texture :
 - (ii) Colour :
-

You are right if your answer is similar in meaning to:

- (i) Texture wise the hair becomes lusterless, straight, soft and sparse.
 - (ii) Colourwise the hair acquires either gray, brown or light yellow colour.
-

87. The fourth clinical features of the disease is "mental apathy" i.e. the child becomes highly irritating. Any attempt to arouse child's interest results in making him cry.

In other words when the child takes no lively interest in the surroundings, he is said to be suffering from a condition called _____.

Answer : mental apathy

88. The fifth clinical feature of the same disease is that the child suffers from diarrhoea and vomiting which is because of poor digestion, which in turn, as you know is, because of the decreased quantity of digestive enzymes namely amylase trypsin, lipase etc., which are all made of protein. When there is no proteins, no enzymes will be formed, and when no enzymes, specially digestive enzymes no food will be digested.

Therefore you can conclude that, no proteins, no enzymes, and no enzymes ____ digestion, and thus when

food is not digested, it will be thrown out of the body through mouth, in the form of _____ (vomits/stools) or from bowels in the form of _____ (vomits/stools).

Answer : no, vomits, stools

89. Having understood thoroughly the reason why Kwashiorkor child's digestion is poor, state the reasons for the following facts.

- (a) Enzymes are not formed in enough quantities when a child suffers from the disease Kwashiorkor.
- (b) Digestion of a Kwashiorkor child is very poor.
- (c) A Kwashiorkor child suffers from vomiting and diarrhoea.

You are right if your answers are similar in meanings to the followings:

- (a) because enzymes are made of proteins and the proteins lack in this disease.
 - (b) because the quantity of digestive enzymes is decreased.
 - (c) because the food is not digested.
-

90. To sum up all the clinical features of Kwashiorkor complete the facts in section A, using the alternatives from the section B, by matching the numbers, in A with these in B.

SECTION-A

- (i) A Kwashiorkor child is under weight.
- (ii) A Kwashiorkor child looks plump and welfed.
- (iii) Hair of a Kwashiorkor child changes, both, colour and the texture wise.
- (iv) A Kwashiorkor child is highly irritating cry-baby.
- (v) A Kwashiorkor child suffers from vomiting.

SECTION-B

- (i) As he suffers from mental apathy.
- (ii) because the quantity of enzymes is reduced because of the protein deficiency.
- (iii) as he fails to grow, due to lack of proteins.
- (iv) as he suffers from oedema.
- (v) because hair is formed of protein and the same lack in the disease Kwashiorkor.

Answer : (i)-(iii); (ii)-(iv); (iii)-(v); (iv)-(i); (v)-(ii)

91. Thus the five external signs or the clinical features of the disease can be, in brief, summarized as follows:

- | | | |
|-----|-----|-----|
| (1) | (2) | (3) |
| (4) | (5) | |
-

You are right if your answers are similar in meaning to the following: The order may differ: (1) Failure to grow, (2) Oedema, (3) Changes in hair, (4) Mental apathy and (5) Vomiting and Diarrhoea.

92. The most important is the treatment of the disease. Since you know the cause of the disease and the foods rich in protein, definitely, you will be able to point out the correct number of the set of foods, from the two sets of foods given below, which will help in the quick cure of the disease.

- (a) Boiled and mashed pulse with a leafy vegetable, half boiled eggs, curds with mashed fruits, banana milk shake, tomato-meat soup, fruit juices, cashewnut power in milk.
 - (b) Cooked rice, boiled potato, sweet bajra gruel, butter milk.
-

Answer : (a)

93. Suppose you find that your poor neighbour's 11 months old child does not gain any weight, since last eight weeks, but yet it appears quite plump. Besides, it never remains cheerful, instead cries all the time, it vomits and passes many stools.

From your knowledge about these clinical features, can you say that he is suffering from any deficiency disease?

- (a) Yes _____, No _____.
 (b) If yes, what disease? _____
 (c) What nutrient is deficient? _____
 (d) What foods can be given to cure the child? Suggest any three food preparations.
 (i) _____ (ii) _____ (iii) _____

Answer : (a) yes, (b) Kwashiorkor, (c) Protein, (d)(i) Pulses or meat soup, (ii) Fruit-milk shake, (iii) half boiled eggs (any such protein-rich preparations pulse or meat soup).

94. Don't you think you have become half doctors, as you could guess the disease as well as could advise the treatment, with foods! But so far you only studied how children are affected by the disease. But you very well known that protein is not only required by the children but also required by the adults and old to maintain the body tissues. Thus they also become victims of effects of protein deficiency. Which are as follows:
- (1) The muscles lack tone and thus these become soft and flabby.
 - (2) Nails break easily.
 - (3) Hair will lose lustre and become sparse.
 - (4) Quantity of haemoglobin falls in red blood corpuscles, due to which enough oxygen is not supplied to the tissues; as a result lack of energy flows.

- (5) Infection sets in because anti-bodies are not produced in sufficient quantities, thus the liability to destroy bacteria is greatly decreased.

Here are the names of the few body constituents which are affected in protein deficiency put them against the right sentences mentioned below:

Muscles, nails, hair, haemoglobin, antibodies.

- (1) I break easily _____.
 (2) You will welcome an infection in my absence _____.
 (3) I do not remain firm but become flabby _____.
 (4) I become lustreless and sparse _____.
 (5) I supply oxygen to all the body tissues to breathe _____.

Answer : (1) Nails, (2) Anti-body, (3) Muscles, (4) hair,
 (5) Haemoglobin

95. Thus the five body constituents affected in protein deficiency chiefly, in case of adults are:

- (1) (2) (3) (4)
 (5)

Answer : The order may differ: (1) Nails, (2) Anti-body,
 (3) Muscles, (4) Hair, (5) Haemoglobin.

96. Do you agree that infants, children adolescents, adults and old all need protein to exist on this earth and that they would lose health and suffer from many ill-effects in protein deficiency. (Yes/No)

Answer : Yes

97. So the lesson on protein can be concluded as; if you wish to grow well and also desire to be attractive and healthy and remain so, through out the years to come, see that your diet provides enough _____ of high biological value right from the infancy till you remain on this planet.

Answer : Proteins

Response-Sheet

PROTEINS

Time : _____

Name: _____

Roll No.: _____

- | | |
|--|---------------------------|
| 1. _____ | 21. _____ |
| 2. _____ | 22. (i) _____ |
| 3. _____ | (ii) _____ |
| 4. _____ | (iii) _____ |
| 5. Number: _____ | (iv) _____ |
| 6. _____ | (v) _____ |
| 7. _____ | 23. Number: _____ |
| 8. _____ | 24. _____ |
| 9. (i) _____ | 25. Answer not needed. |
| (ii) _____ | 26. (a) Leu_____, Ly_____ |
| (iii) _____ | (b) Try_____, Threo_____ |
| 10. _____, _____, _____, _____ | (c) Val_____, Iso_____ |
| 11. (a) _____ | Methi_____, Phenyl_____ |
| (b) _____ | (d) Argi_____, His_____. |
| (c) _____ | 27. (i) _____ |
| (d) _____ | (ii) _____ |
| 12. _____ | (iii) _____ |
| 13. (a) _____ (b) _____ | (iv) _____ |
| (c) _____ (d) _____ | (v) _____ |
| 14. (A) _____ (B) _____ (C) _____ | (vi) _____ |
| 15. _____ | (vii) _____ |
| $\begin{array}{c} \\ -C- \\ \end{array}$ | (viii) _____ |
| 16. Pep_____, lin_____. | (ix) _____ |
| 17. _____ | (x) _____ |
| 18. (a) _____ (b) _____ | 28. (1) _____ |
| (c) _____ (d) _____ | (2) _____ |
| (e) _____ | (3) _____ |
| 19. (a) _____ (b) _____ (c) _____ | (4) _____ |
| (d) _____ (e) _____ (f) _____ | (5) _____ |
| 20. (i) _____ (ii) _____ | (6) _____ |
| (iii) _____ (iv) _____ | (7) _____ |
| | (8) _____ |
| | (9) _____ |
| | (10) _____ |

29. Answer not needed

30. (i) Glue _____ Acid
 (ii) Aspar _____ Acid
 (iii) Pro _____
 (iv) Hydro _____

31. (i) _____
 (ii) _____
 (iii) _____ (iv) _____
 (v) _____

32. (a) (b) (c)
 (d) (e) (f)

33. _____

34. A(i) _____
 (ii) _____
 B(i) (ii) (iii)
 (iv) (v) (vi)
 (vii) (viii)

35. (I) (a) _____
 (b) _____
 (II) Number:

36. (a)
 (b)

37. (1)
 (2)
 (3)
 (4)

38. _____

- | Complete
Prot. | Incomplete
Proti. |
|-------------------|----------------------|
| i) _____ | _____ |
| ii) _____ | _____ |
| iii) _____ | _____ |
| iv) _____ | _____ |

40. _____

41. (i)
 (ii)
 (iii)
 (iv)
 (v)

42. _____, _____

43. (i)
 (ii)

44. _____

45.

46. (i) (ii) (iii)
 (iv)

47. _____

48. _____

49. (a) (b) (c)
 (d) (e)

50. _____

51. (a) _____, (b)(i) _____
 (ii) _____ (iii) _____
 (iv) _____

52. (1) _____ (2) _____ (3) _____

53. 1. 2. 3. 4. 5. 6.
 7. 8. 9. 10. 11. 12.

54. 1. 2. 3.
 4. 5. 6.

55. (a) (b) (c)
 (d) (e) (f)

56. _____

57. _____

58. _____

59. _____
60. _____
61. _____
62. _____
63. Answer not needed
64. _____
65. _____
66. _____
67. _____
68. _____
69. _____
70. (i) _____ (ii) _____
(iii) _____ (iv) _____
71. _____
72. _____
73. (i) _____ (ii) _____
(iii) _____ (iv) _____
74. _____
75. _____
76. _____
77. (a) _____ (b) _____,
_____, _____ (c) _____.
78. (i) _____
(ii) _____
(iii) _____
(iv) _____
79. _____
80. _____
81. _____
82. _____
83. Number: _____
84. (a) _____ (b) _____
85. _____
86. (i) _____
(ii) _____
87. _____
88. _____
89. (a) _____
(b) _____
(c) _____
90. Numbers
91. 1) _____ 2) _____
3) _____ 4) _____
5) _____
92. _____
93. (a) _____ (b) _____ (c) _____
94. 1) _____ 2) _____ 3) _____
4) _____ 5) _____
95. 1) _____ 2) _____ 3) _____
4) _____ 5) _____
96. _____
97. _____

Appendix B₂
Programmed Learning Material
Unit II
CARBOHYDRATES

Besides proteins to be healthy, we also require the other nutrient called 'Carbohydrates' concerning which we will study the following points.

- (i) Chemical composition of carbohydrates.
- (ii) Meaning of the term 'Carbohydrate'.
- (iii) Process of photosynthesis.
- (iv) An important function of carbohydrates.
- (v) Recommended allowance of carbohydrates.
- (vi) Sources of carbohydrates.
- (vii) Kinds of carbohydrates, including their properties, food-sources and digestion.
- (viii) Diabetes, the ill effect of excessive consumption of carbohydrates.

-
1. You have observed in the first section that proteins are made of Carbon, Hydrogen, Oxygen and Nitrogen, (CHON). Do you know what carbohydrates are made of? Carbohydrates are made of Carbon, Hydrogen and Oxygen (CHO).

Therefore we can state that the only difference in the Chemical Composition of Proteins and Carbohydrates is that, like proteins carbohydrates contain _____, _____, and _____, but do not contain _____ which is also present in proteins.

Answer : carbon, hydrogen, oxygen, nitrogen.

2. You are right! Knowing the chemical composition state below the three constituents which together compose carbohydrates.

(i) _____, (ii) _____ and (iii) _____

Answer : (i) carbon, (ii) hydrogen, (iii) oxygen

3. Thus in short we can also say that as proteins are made of CHON, Carbohydrates are made of _ _ _.

Answer : C H O

4. You have noticed that compounds containing carbon, hydrogen and oxygen are called carbohydrates. The term Carbohydrates is the combination of two words, Carbo and hydrates. 'Carbo' stands for carbon atoms, and 'hydrates' indicates that generally hydrogen atoms, and oxygen atoms, are present in the proportion of two hydrogen atoms to one oxygen atom, so as to form water (H_2O); from which fact the term carbohydrate (carbon + hydrate) was derived.

Read the above mentioned paragraph carefully and answer the following questions only in words.

- (a) What does the word 'carbo' stand for?
- (b) What is the ratio of hydrogen and oxygen atoms in a carbohydrate?
- (c) What is formed due to that proportion of hydrogen and oxygen?
- (d) Out of the two words, 'carbo' and 'hydrates' of which the term 'carbohydrate' is made of, which word expresses that proportion of hydrogen and oxygen atoms, form water?

Answer : (a) For carbon atoms, (b) 2:1 (two molecules of hydrogen to one molecule of oxygen), (c) H_2O or (water), (d) Hydrate.

5. Very Good! Having answered the above questions correctly now you will be able to complete the following statement:

Carbohydrates are called so because _____

Answer : You are right, if your answer is similar in meaning to the following:

Carbohydrates contain carbon atoms therefore the word "Carbo" and hydrogen and oxygen atoms are present in the ratio of 2:1 (H_2O) which means to form water and hence the word "hydrate".

Carbo + hydrate = Carbohydrate.

6. Fine! You have secured a good hold on the term 'carbohydrates'. Do you know where the carbohydrates are originally prepared? Perhaps not. Don't worry. Read ahead and you will get the answer. Plants are the nature's carbohydrates manufacturers. The green colouring matter in the plant leaves called chlorophyll, utilizes water of the soil, carbon-dioxide of the atmosphere and synthesizes carbohydrates in the presence of sunlight.

It can be thus concluded that chiefly four things are necessary in the formation of carbohydrates. These are :

- (i) _____, the green plant pigment in the leaves.
- (ii) _____, from the soil.
- (iii) _____, the gas in the atmosphere.
- (iv) _____, of the sun.

Answer : (i) Chlorophyll, (ii) Water, (iii) Carbon-dioxide, (iv) Light.

7. From the above fact, it can be stated that;

"The part of the plant called _____ (roots, stem, leaves) is the kitchen of the plant where carbohydrates are prepared".

Answer : leaves

8. The process by which plant-leaves manufacture carbohydrates is called PHOTOSYNTHESIS. The term photosynthesis is formed of two words. "Photo" meaning light and "Synthesis" meaning to make.

Therefore the term photosynthesis completely means to make something in presence of _____; in this connection it being the _____ (moon, sun, electric) light.

Answer : light, sun

9. This explains that photosynthesis is only possible during the _____ (day/night) and not at _____ (day/night) as there is no sunlight at night.

Answer : day, night

10. This process of photosynthesis is probably the most important reaction for the continuance of life on this earth, for the energy thus stored in the plant is used in turn by human beings and animals.

In other words, life depends on this photo_____thetic process, since the carbohydrates synthesized and stored by the plant kingdom are the major source of energy or calories on which the human beings and all plant eating animals depend.

Answer : tosyn

11. Now try to solve the following questions very briefly.

(a) Explain in detail the meaning of the word "photosynthesis".

- (b) Would photosynthesis take place at night? Why?
- (c) Which nutrient is synthesized by the process of photosynthesis?
- (d) In which part of the plant photosynthesis occurs?
- (e) Why do we say that life depends on photosynthetic process?

Answer : You are right, if your answer is similar in meaning to the following:

- (a) Photo means light and synthesis means "to make".
Therefore photosynthesis completely means "to make something in presence of light".
- (b) No. Because there is no sunlight at night.
- (c) Carbohydrates
- (d) Green leaves
- (e) Because human beings and most of the plant eating animals chiefly depend upon carbohydrates as the major source of energy.

12. Thus we can also say that the main function of carbohydrates is to give energy. Since it is a fuel, it burns or oxidizes in the body to produce heat. You already know that heat produced in the body on oxidation or burning of nutrient is nothing but energy or calories. It is clear that carbohydrates being a fuel, oxidize in the body to give energy or calories. But how much energy or how many calories do carbohydrates give on oxidation? The answer is "Exactly like proteins, one gram of carbohydrate gives 4 calories, when oxidized in the body.

Write the answers of the following questions in a word in the space provided under each question.

- (a) Like protein, which other nutrient gives you energy?

(b) Which process helps these nutrients to release energy in the body?

(c) How many calories we get from one gram of carbohydrate when it oxidizes in the body?

Answer : (a) Carbohydrates (b) Oxidation (c) Four

13. To obtain sufficient energy, the daily diets of an adult should include approximately 350 grams of carbohydrates.

In exact, words, the recommended allowance or the daily requirement of carbohydrates for an adult person is approximately _____ grams.

Answer : 350

14. Suppose your whole day diet contains 350 gms. of carbohydrates.

Can you calculate and show how many calories you can get from 350 grams of carbohydrates?

Answer : Gram of CHO gives calories

	1		4	
∴ 350	"	"	"	? 350 x 4 = 1400 calories

15. Very Good! You have calculated the right number of calories. You know that carbohydrates provide us calories or energy. But which foods should you eat to get the carbohydrates? As such carbohydrates are present in almost all the foods in more or less quantity, except fats and oils, which contain absolutely no carbohydrates.

From the list of foods given below, tick (✓) mark the foods which contain carbohydrates and put X against the foods which do not contain carbohydrates.

(a) Rice; (b) Potatoes; (c) Butter; (d) Sugar; (e) groundnut oil; (f) Green-gram; (g) Dalda, and (h) Pure ghee.

Answer : (a) ☐; (b) ☐; (c) X; (d) ☐; (e) X; (f) ☐; (g) X; and (h) X.

16. It can be also stated that you can obtain carbohydrates from any food in your daily diets except from _____ and _____ which contain totally no carbohydrates, and thus are rich/poor sources of carbohydrates.

Answer : fats, oils, poor

17. On the other hand, sugar and jaggery are the concentrated sources or the richest sources of carbohydrates as these contain 99.4% and 95% of carbohydrates respectively. But we do not use them as much as we use the other foods as they are only the sweetening agents. CEREALS like rice, wheat, bajra, jowar containing about 65% to 70% of carbohydrates, and which form the bulk of Gujarati daily diets, are rich sources of carbohydrates. Besides cereals we also get good quantity of carbohydrates from ROOT VEGETABLES in our daily meals. These are also the rich sources of carbohydrates. Pulses, nuts and oil-seeds which also contain considerable amounts of carbohydrates, are next important sources of carbohydrates. Amongst fruits and vegetables, sweet fruits and root vegetables contain moderate amount of carbohydrates. Leafy vegetables and the other vegetables are very low in their carbohydrate content.

Now state in words which two are the rich sources of carbohydrates?

Answer : Cereals and root vegetables

18. Fill in the blank with the appropriate word from the bracket.

- (a) Sugar and Jaggery are the _____ sources of carbohydrates. (rich, poor, richest).
- (b) Cereals are _____ sources of carbohydrates. (rich, poor, richest)
- (c) Fats and oils are the completely _____ sources of carbohydrates. (rich, poor, richest)

Answer : (a) richest; (b) rich; (c) poor

19. You have gathered that except fats and oils, most of the foods contain more or less amount of carbohydrates. But the carbohydrates present in different foods are not of the same kind, e.g. Sugar is very sweet, whereas rice is not, although both contain a lot of carbohydrates. Different kinds of carbohydrates, having significance in nutrition are broadly classified into three main groups. They are :

- (i) Mono saccharides; (ii) Di-saccharides, and (iii) Poly-saccharides.

Which are the three main kinds of carbohydrates?

Answer : The order may differ:

- (i) Mono-saccharides; (ii) Di-saccharides, and (iii) Poly-saccharides.
-

20. The first kind of carbohydrates are the Mono-Saccharides. Mono means 'one' and Saccharide means 'sugar'.

Therefore mono-saccharide completely means 'one sugar' or in better words _____ (single/double) sugars, or _____ (simple/complex) sugars.

Answer : single, simple

21. The examples of simple or single sugars, or mono-saccharides are (i) Glucose (ii) Fructose and (iii) Galactose. These are all water soluble sugars and not affected by the digestive enzymes.

Study the above information thoroughly and complete the following facts.

Mono - Saccharides

- | | |
|--|--|
| <p>(a) The three names are:</p> <p style="margin-left: 40px;">(i)</p> <p style="margin-left: 40px;">(ii)</p> <p style="margin-left: 40px;">(iii)</p> | <p>(b) The two common properties are:</p> <p style="margin-left: 40px;">(i)</p> <p style="margin-left: 40px;">(ii)</p> |
|--|--|

Answer : (a) The order may differ. (b) the order may differ.

<p style="margin-left: 40px;">(i) Glucose</p> <p style="margin-left: 40px;">(ii) Fructose</p> <p style="margin-left: 40px;">(iii) Galactose</p>	<p style="margin-left: 40px;">(i) They are water soluble.</p> <p style="margin-left: 40px;">(ii) They are not affected by the digestive enzyme.</p>
---	---

22. Answer the following questions in very brief.

- (i) Which kind of carbohydrates are glucose, fructose and galactose?
- (ii) Are glucose, fructose, galactose soluble in water?
- (iii) Are glucose, fructose, galactose broken down further in the digestive tract by the action of enzymes?

Answer : (i) Mono-saccharides; (ii) yes; (iii) No.

23. Out of the three names of mono-saccharides or simple sugars, which you learnt; GLUCOSE is widely distributed in nature, and is found in almost all the fruits and vegetables. Some of the cereals also contain glucose when they are not fully matured.

Besides these foods, glucose is also found in blood, and therefore it is also called the blood sugar.

Answer very briefly.

(a) Which foods contain glucose?

(b) Why it is referred to as the blood sugar?

Answer : (a) Fruits, vegetables, immature cereals;

(b) It is referred to as the blood sugar because it is found in blood.

24. Therefore, in all, glucose occurs in three foods namely _____, _____ and _____; and in a body tissue, which circulates in whole body called _____.

Answer : Fruits, Vegetables, immature cereals, blood.

25. You know that glucose is found in blood. But how much glucose is found in blood? The answer is : The normal blood glucose level is 80 mgs. to 90 mgs. per every 100 ml. of blood. This can be also expressed as "80 to 90 mgs. glucose/100 ml. blood".

State whether the sentences below are true or false. Correct the false statement.

(i) The carbohydrates, present in blood is called glucose.

(ii) The normal blood glucose level is 80 to 90 mgs. of glucose/1000 ml. of blood.

Answer : (i) True; (ii) False. It is 80 to 90 mg. glucose/100 ml. blood.

26. Besides the glucose, we find in natural foods like cereals, fruits and vegetables, and in blood, which has been absorbed from the digested food; synthetic pure glucose powder is also sold in the market under the name "Glucose-D" which is consumed by the people to get energy. The taste of glucose-D is sweet. Since this

pure glucose powder, sold as glucose-D is most readily absorbed by the blood and utilized by the body to release energy, it is administered to weak and sick people.

In other words pure _____ is used as the ready source of _____ for the weak and sick persons who are not able to take enough food; because it is readily _____ and _____ by the body.

Answer : glucose, energy, absorbed, utilized.

27. Can you say, which is the mono-saccharide, given to sick people and why it is given to them?

Answer : Glucose is the mono-saccharide given to sick people as it is readily absorbed and utilized by the body as a source of energy.

28. Like glucose, the second mon-saccharide is FRUCTOSE. It is chiefly found in ripe fruits. Besides ripe fruits, fructose is present in honey and in many vegetables. Fructose is very sweet in taste. It is about 2.5 times sweeter than glucose.

Learning about fructose, complete the following sentences.

- (1) Fructose is present in _____.
- (2) Fructose is sweeter than glucose about _____.

Answer : (1) ripe fruits, honey, vegetables.

(2) 2.5 times sweeter than glucose.

29. You also know that fructose being a simple sugar, remains unchanged during digestion. But it is utilized by our body only after it is converted to glucose.

Do you agree that fructose is not affected by digestive enzymes, but is utilized in the different form i.e. after being changed to glucose? ____ (Yes/No)

Answer : Yes

30. Having learnt about fructose in detail, check whether you have remembered all the points concerning the same, by answering the following questions, only in words.

- (i) In which all foods, does it occur?
- (ii) How many times it is sweeter than glucose?
- (iii) Does it change during digestion?
- (iv) In what form, our body can use fructose?

Answer : (i) In ripe fruits, vegetables and honey; (ii) 2.5 times; (iii) Remains unchanged; (iv) in the form of glucose.

31. Besides, glucose and fructose, GALACTOSE is also a mono-saccharide. It does not occur alone in nature. It occurs in combination with glucose in the milk to form milk-sugar.

In brief, the mono saccharide, that does not occur alone in nature like glucose and fructose, but is found in combination with glucose, forming milk-sugar is called _____.

Answer : galactose

32. It can be thus concluded that, out of the three mono-saccharides, that you studied the first two i.e. glucose and fructose are of _____ (plant/animal) origin, whereas, the third one called _____, since it is present in milk is of _____ (plant/animal) origin.

Answer : Plant, galactose, animal

33. You have noticed that galactose is found in combination with glucose to form milk sugar. The chemical name of the milk sugar so formed is LACTOSE. In simple terms it can be written as;

Glucose + Galactose -----> Lactose.

Having followed how lactose is formed, you will definitely be able to answer the following questions.

- (i) Which food sugar, is lactose?
- (ii) Which two mono-saccharides together form lactose?

Answer : (i) Lactose is the milk sugar.

(ii) Glucose and galactose join together to form lactose.

34. So lactose is the compound formed when two mono-saccharides combine. Any compound of sugar which results from the joining of the two mono-saccharides is called a Di-Saccharide. Obviously the term di-saccharide is the combination of two words, 'di' and 'saccharide'.

Since 'Di' means two and 'saccharide' means sugar, di-saccharide fully means two sugars or specifically a _____ (single/double) sugar.

Answer : double

35. As suggested through the meaning; a di-saccharide is a compound having two sugars. To be more correct "A di-saccharide is formed of two mono-saccharides".

Therefore lactose, the milk sugar which is formed of two mono-saccharides namely _____ and _____; is also a _____.

Answer : glucose, galactose, di-saccharide

36. Besides lactose, our common table sugar, which is used as the sweetening agent, chemically known as SUCROSE, is also an example of a di-saccharide. Since sucrose is a di-saccharide, it is formed when two mono-saccharides, namely GLUCOSE and FRUCTOSE combine. In short it can be stated as "GLUCOSE + FRUCTOSE = SUCROSE".

Having followed the composition of sucrose answer the following questions in brief.

- (a) Why sucrose is called a di-saccharide?
- (b) Which two mono-saccharides form sucrose?

Answer : (a) because it is composed of two mono-saccharides.
(b) glucose and fructose.

37. You know that sucrose is nothing but sugar; and the sugar is prepared out of sugar cane and sugar beets; therefore these are also the sources of sucrose. Besides sugar cane and sugar beets, sucrose is also found in many sweet fruits, and therefore it is also called 'fruit sugar'.

In simple terms the food sources of sucrose are
(i) _____, (ii) _____, and (iii) sweet _____.

Answer : Sugar-cane, sugar-beets, fruits.

38. Sucrose which occurs in sweet fruits, is the same as sugar and therefore it is also sweet, but it is 1.5 times sweeter than glucose.

Well : You have studied many facts concerning sucrose. Now write a paragraph on sucrose, including all the following points.

- (i) Its composition
 - (ii) Its food sources
 - (iii) The sweetness compared to glucose
 - (iv) Its common name
 - (v) It is also called
-

Answer : You are right if your answer is similar in meaning to the following.

Sucrose is formed of glucose and fructose. It occurs in sweet fruits, sugar cane and sugar beets. It is 1.5 times sweeter than glucose. It is same as the sugar. It is also called as fruit sugar.

39. Correct! We studied two di-saccharides, (i) lactose and (ii) sucrose. The third example of the same is MALTOSE. Being a di-saccharide, maltose is also made up of two mono-saccharides namely glucose and glucose. It can be also stated as : Glucose + Glucose = Maltose.

In other words two molecules of _____ together form maltose.

Answer : glucose

40. Maltose is called so, because it is found in malted cereals i.e. in the germinated or sprouted cereals. Maltose is the chemical name of cereal sugar.

Understanding the reason why maltose is called so; complete the following statement.

Cereal-sugar, chemically known as maltose, is called so _____.

Answer : because it is found in malted cereals

41. Fine! Now check completely whether you know all the points about maltose by answering the following questions in brief.

- (i) What kind of a carbohydrate maltose is?
- (ii) What mono saccharides compose it?
- (iii) Which foods contain maltose?
- (iv) What it is commonly known as?

Answer : You are right if your answer is similar in meanings to the following:

- (i) It is a di-saccharide
 - (ii) Two molecules of glucose compose maltose
 - (iii) It is found in malted cereals
 - (iv) It is commonly known as cereal sugar
-

42. Very Good! Now, having studied all the three di-saccharides you will be able to complete the following table.

Common name	Chemical name	Mono-saccharides in the composition	Occurs in food group
Cereal-sugar			
Fruit sugar			
Milk sugar			

Answer :

Common name	Chemical name	Mono-saccharides in the composition	Occurs in food group
Cereal-sugar	Maltose	Glucose + glucose	Malted cereal
Fruit sugar	Sucrose	Glucose + fructose	Sweet fruits
Milk sugar	Lactose	Glucose + galactose	Milk

43. All these three di-saccharides are digested in the small intestine by the enzymes. Small intestine has three enzymes namely SUCRASE, MALTASE and LACTASE which act on sucrose, maltose and lactose respectively.

You have noticed that three different enzymes in the small intestine, act on three different di-saccharides. Write the name of an enzyme that helps digestion of each of the following.

<u>Sugar</u>	<u>Enzyme</u>
(i) Sucrose	
(ii) Lactose	
(iii) Maltose	

Answer : (i) Sucrase, (ii) Lactase, (iii) Maltase.

44. During digestion sucrase acts on sucrose and breaks it down into glucose and fructose, lactase acts on lactose and splits it into glucose and galactose; and maltase acts on maltose and breaks it into glucose and glucose.

In short it can be written as -

- (a) Sucrose---Sucrase--- Glucose +
- (b) Lactose---Lactase--- +
- (c) Maltose---Maltase--- +

Answer : (a) Fructose
 (b) Glucose + Galactose
 (c) Glucose + Glucose

45. The mono-saccharides, thus obtained through digestion of di-saccharides in the small intestine, are ready for absorption by the blood. We studied about two groups of carbohydrates namely, mono-saccharides, and di-saccharides. Now let us get acquainted with the third group of carbohydrates called the Poly-Saccharides.

Like mono-saccharide and di-saccharide the term poly-saccharide is also made of two words poly meaning _____ and saccharide meaning _____.

Answer : many, sugar

46. Since 'poly' means many and 'saccharide' means sugar, poly-saccharide completely means a _____ (multiple/single/double) sugar.

Answer : multiple

47. Just as a di-saccharide is so called because it is made of two molecules of mono-saccharides, a poly saccharide or a multiple sugar is so called as it is made of _____ (many/two) molecules of mono-saccharides.

Answer : many

48. The poly-saccharides are not sweet and generally insoluble in water.

Or you can also say that the two common properties of poly-saccharides are:

(i) _____ (ii) _____.

Answer : The order may differ:

(i) They are not sweet (ii) They are insoluble in water.

49. Some of the examples of poly-saccharides having importance in nutrition are (i) Starch (ii) Glycogen and (iii) Cellulose. Out of these three STARCH is the most common Poly-Saccharide used by human beings and animals because it is in the form of starch that PLANTS store carbohydrates and thus it is the principle and primary source of energy for human beings and animals. You know that starch is a poly-saccharide and therefore, it is not made of one or two molecules of mono-saccharide but it is composed of many molecules of mono-saccharides called glucose.

Use the underlined word or words, to answer the following questions.

- (i) In what form plants store carbohydrates which we use as our chief source of energy food?
- (ii) What kind of a carbohydrate the starch is?
- (iii) What is starch composed of?

Answer : (i) starch (ii) a poly-saccharide (iii) many molecules of glucose

50. The chief foods which contain starch are cereals and root vegetables.

In other words, cereals such as _____, _____ etc., and root vegetables such as _____, _____ etc. contain carbohydrates in the form of _____.

Answer : Rice, wheat (or any two cereals), potato, sweet potato (or any two root vegetables), starch.

51. Having learnt the sources of starch, tick (✓) mark the foods which contain starch.

(a) Bajra, (b) Radish, (c) Rice, (d) Fish, (e) Mango,
(f) Eggs, (g) Yam, (h) Meat, (i) Lemon, (j) Potato.

Answer : (a) ✓, (b) ✓, (c) ✓, (g) ✓, (j) ✓

52. Like starch, glycogen is the other poly-saccharide composed of many glucose units.

In other words starch and glycogen are _____
(similar/different) in their chemical composition.

Answer : similar

53. Right! Starch and glycogen are similar in their chemical composition. But they differ in the sources from which they are obtained.

The starch is present in the plant food whereas the glycogen is found in _____ (animal/plant) tissues.

Answer : animal

54. You have noticed that unlike starch, glycogen is found in the animal tissues but has the same chemical composition as the starch. Therefore glycogen is also called as the animal starch.

Will you now write the reason for the following statement?

Glycogen is also referred to as the animal starch, because _____.

Answer : it is found in the animal tissues and has the same chemical composition as the starch.

55. Having understood the main sources of starch and glycogen say which of the following have glycogen and starch.

- | | |
|------------------|---------------|
| (i) Sweet potato | (iii) Muscles |
| (ii) Liver | (iv) Yam |

Answer : (i) Starch, (ii) Glycogen, (iii) Glycogen,
(iv) Starch.

56. Thus we can conclude that just as plants store carbohydrates in the form of _____, liver and muscle tissues store carbohydrates in the form of _____.

Answer : starch, glycogen

57. Glycogen is formed in the body from the extra glucose absorbed and is then stored in the liver.

In simple terms excess _____ is converted to
_____ and stored in _____.

Answer : Glucose, Glycogen, liver

58. You know that glycogen so formed, is stored in the LIVER and animal tissues. But the percentage of glycogen stored in the liver is more than that stored in the muscle tissues. Besides, the liver glycogen is reversibly convertible to glucose which can be used by the body as an immediate source of energy when the dietary supply of carbohydrate is inadequate.

Therefore, it is right to mention that the _____
is the chief store-house for glycogen.

Answer : Liver

59. Some of the starch from the only cooked cereals and cooked root vegetables present in our daily diets, is digested in the mouth by an enzyme in the saliva called PTYLIN, during the process of chewing when the food mixes with saliva.

Read the above information carefully and choose the correct word in the bracket which serves as an answer to each question.

- (i) Where does the digestion of starch begin?
(stomach, mouth, intestine)
- (ii) What juice is present in mouth? (Pancreatic juice, saliva)
- (iii) What does saliva contain? (Enzyme, Hormone)
- (iv) What is the name of the enzyme present in saliva?
(Peptin, Amylopsin, Ptylin)
- (v) What is the function of the ptylin? (to absorb, to digest)
- (vi) Ptylin helps digestion of which nutrient?
(cooked starch, cooked food)

Answer : (i) Mouth, (ii) Saliva, (iii) Enzyme, (iv) Ptylin,
(v) to digest, (vi) cooked starch.

60. Only some of the cooked starch is digested by ptylin of saliva, but the remaining starch whether cooked or uncooked, which escapes digestion in the mouth, is then digested in the pancreas by the enzyme called AMYLOPSIN present in pancreatic juice.

Study the above paragraph very thoroughly and tick (✓) mark the only true sentences given below:

- (i) All the starch is digested in the mouth.
- (ii) Amylopsin is the enzyme which helps in the digestion of cooked and uncooked starch.
- (iii) Amylopsin is present in the pancreas.

Answer : (ii), (iii)

61. These starch splitting enzymes, acting on starch, split it into maltose; during digestion.

In other words the smallest molecules formed by the action of starch splitting enzyme is the disaccharide called _____.

Answer : maltose

62. The same maltose resulting from the digestion of starch is acted upon by maltase which breaks it into two units of _____.
-

Answer : glucose

63. Thus we can state that starch, a polysaccharide, which is originally formed of many molecules of glucose is broken down into many molecules of _____ only, by the starch splitting enzymes during digestion.
-

Answer : glucose

64. In short starch and glycogen are such two polysaccharides which are utilized by our body. The third polysaccharide namely CELLULOSE although present in our daily foods is not utilized by our body.

Can you say in brief -

- (a) The two polysaccharides used by our body are
(i) _____ and (ii) _____.
(b) The polysaccharide which is not utilized by our body is _____.
-

Answer : (a) (i) Starch and (ii) Glycogen, (b) Cellulose

65. Cellulose is not utilized by our body but voided through faeces, because it is not digested in our body; as our digestive system lacks in the enzyme called cellulase which helps in the digestion of cellulose.

It can be derived from the above fact that human being cannot use cellulose as their digestive system does not have the enzyme called _____ which helps in the digestion of cellulose.

Answer : cellulase

66. Cellulose which is not utilized by our body is found in the plant foods like starch, which, as we noted is also found in the plant foods. But the difference between starch and cellulose is that starch is found in the edible portions of the plant foods, whereas cellulose is found in the non-edible portions of the plant foods like peels of fruits and vegetables and in the coatings of cereals and pulses often spoken of as roughage.

Understand the above paragraph and choose the right words to fill in the gaps:

edible, non-edible, cellulose

Greengram has both the polysaccharides, starch and _____ present in it, but the only difference is that the starch is found in its _____ portion, whereas cellulose is found in its outer coating, it being the _____ portion.

Answer : cellulose, edible, non-edible.

67. Although cellulose is a non digestible dietary constituent, it offers a valuable service by forming bulk which makes for intestinal hygiene.

Do you agree, that it helps us to be healthy by allowing intestinal waste to be voided regularly thus preventing the tendency to constipation? ____ (Yes/No)

Answer :

68. We discussed that though cellulose contributes little to the nutritive value of food, we must include cellulose or roughage containing foods in our daily diets as it helps in the elimination of bowels waste.

Knowing the need for cellulose in our daily meals tick (✓) mark against the sentence which indicates the function of cellulose in our body.

- (i) Cellulose being a poly-saccharides provides us energy.
- (ii) Cellulose being a roughage helps to avoid constipation by maintaining intestinal hygiene.

Answer : (ii) ✓

69. It is obvious that cellulose, being not digested is thrown out of our body unused. The same cellulose which we cannot digest and utilize plant-eating animals like cows, sheep, goat, etc. can digest and use it as the source of energy.

Can you guess the reason, why animals can digest cellulose?

OR

What is that which is required for cellulose digestion, which human beings do not have, but plant eating animals would have?

Answer : You are right if your answer is similar in meaning to the following:

- (a) Plant eating animals can digest cellulose as their digestive system consists of an enzyme called cellulase which is needed for the digestion of cellulose.

OR

- (b) It is the enzyme 'cellulase'.

70. It can be now concluded that the two poly-saccharides which do not undergo digestion are (i) stored in the liver namely _____ and (ii) _____ found in the non-edible parts of the plant foods.

Answer : (i) Glycogen; (ii) Cellulose

71. But the poly-saccharide that needs to be digested before it is utilized, is _____.

answer : Starch

72. In short all the mono-saccharides, being simple sugars require no digestion. They can readily pass through the absorbing walls of small intestine. All the di-saccharides being compound sugars undergo digestion and amongst three poly-saccharides, only starch is digested.

Understanding the digestion of all the carbohydrates, put 'D' against the names of the sugars which need digestion and X against the names of the sugars either need no digestion or do not undergo any digestion.

- | | |
|-----------------|-----------------|
| (i) Starch | (vi) Glycogen |
| (ii) Fructose | (vii) Galactose |
| (iii) Cellulose | (viii) Sucrose |
| (iv) Maltose | (ix) Lactose |
| (v) Glucose | |

Answer : (i) 'D'; (ii) X; (iii) X; (iv) 'D'; (v) X; (vi) X; (vii) X; (viii) 'D'; (ix) 'D'.

73. Very Good! You have very well followed which carbohydrates require digestion, and which do not. Generally nutrients are absorbed by the blood, after they are digested nutrients are taken to the different tissues for utilization by the blood circulating in the body.

Having understood what happens to the food we eat, before it is utilized by the body, arrange the following words in their proper order.

Digest -- Eat -- Utilize -- Absorb

Answer : Eat -- Digest -- Absorb -- Utilize

74. Correct! It is in the same way that the carbohydrates are also absorbed and then utilized by the body. But it is important to note here, that almost all the carbohydrates which are utilized by the body, are utilized in the form of glucose. The mono-saccharides, other

than glucose, i.e. galactose and fructose, the same also obtained during digestion of di-saccharides by enzymatic break down; and converted into glucose and utilized by the body. Mono-saccharide glucose and the number of glucose molecules formed when the starch is digested by enzymes, are used as glucose only.

In brief body utilizes carbohydrates in the form of _____.

Answer : glucose

75. You already know that blood contains, certain normal amount of glucose. If our body does not make enough use of the total carbohydrates, we eat daily, then the extra glucose formed, remains un-used and accumulates in the blood.

Study the above fact and answer the following question only in a word.

In what, does the extra un-used glucose gather in the body?

Answer : Blood

76. The glucose would remain unused if the hormone INSULIN is not secreted in enough quantity by the cells of pancrease called Islets of Langerhans.

In other words the hormone _____, produced by _____ of _____ the cells of pancrease, is necessary for the utilization of glucose in our body.

Answer : insulin, islets, langerhans

77. Besides the deficiency of insulin, if we consume foods containing carbohydrates, in too much quantities, daily; i.e. more than the demands of our body, then also the extra glucose formed will not be utilized by our body, but it will gather in our blood.

In simpler terms, if we daily eat root vegetables, cereals and very sweet dishes prepared out of sugar and jaggery, in excess, the _____ also would be formed in excess, the part of which being not utilised by the body will pile up in _____.

Answer : glucose, blood

78. Therefore the two reasons, for more glucose being found in the blood are, (i) Lack of _____ secretion and (ii) _____ rich foods consumed in excess amounts which is not needed by the body.

Answer : insulin, carbohydrate

79. You know that the normal blood level of glucose, is 80 to 90 mgs. of glucose/100 ml. of blood. This level rises within half an hour after the meal, depending upon the amount of carbohydrates present in the diet. If on analysing the blood in the laboratory, this level is found to be 140 to 150 gms./100 ml. of blood for more than three hours, after the meal, the person is said to be suffering from the disease DIABETES.

Learn the facts in the above paragraph and complete the following statements :

- (i) Normal blood level of glucose is 80 to 90 mgs./100 ml. of blood, which _____, half an hour after the meal.
- (ii) If the normal blood glucose level rises as high as _____ and remains constant for more than _____ hours, the person has become the victim of the disease _____.

Answer : (i) Rises

- (ii) 140 to 150 mgs/100 ml. of blood, three, diabetes.
-

80. The dictionary meaning of 'Diabetes' is "To pass through". In this disease Glucose passes through Urine.

Besides the blood level of glucose going high, what else, happens in Diabetes?

Answer : Glucose passes through urine

81. Urine of a diabetic patient when tested in the laboratory, is found to contain glucose because when blood can not tolerate excess of glucose, it is thrown out of the body via urine.

Learning the disorders that occur in case of a diabetic patient, tick mark (✓) the most correct answer in the following :

- (i) Blood level of glucose is high in diabetic patient.
- (ii) Diabetic patient passes glucose in the urine.
- (iii) Besides the high level of glucose, a diabetic person also passes glucose in the urine.

Answer : (iii) ✓

82. (a) State in brief :

Which, two body fluids are tested in the laboratory to detect the presence of the disease diabetes?

- (b) What do these fluids' tests show, if the person suffers from diabetes?

Answer : (a) Blood and Urine

- (b) Blood level of glucose is more than 140 mgs. to 150 mgs./100 c.c. of blood, and urine also contains glucose.
-

83. The disease diabetes, in which blood and urine are affected is such a disease which cannot be cured

completely, but it can be controlled. A diabetic patient is generally advised to take his meal after taking an injection of insulin, so that the carbohydrates, ingested through diet, are utilized by the body. He is also instructed to avoid the foods like cakes, puddings, custards, jams, jellies, chikkies, chocolates, chewing gums, cocoa cola, fanta, sherbats, cordials sweet fruits, potatoes, yam, rice etc. which are very rich in carbohydrates and which help to elevate the glucose level in blood. To be on safe side a diabetic patient must eat a low calorie diet, avoiding carbohydrate and also fat rich foods, but including plenty of vegetables, sprouted pulses, fermented foods, bread, boiled eggs and meat, milk and curds; and citrous fruits.

Answer the following questions in brief.

- (a) Which are the two ways by which diabetic patient can control the increase in the blood glucose level and the passing of sugar in the urine?
 - (i)
 - (ii)
- (b) Knowing the foods allowed for a diabetic patient, plan an after-noon meal for him, including any four cooked preparations.

Answer : (a) (i) By taking insulin injection before meal.
 (ii) By avoiding carbohydrates rich foods.

(b) Mix vegetables, fatless chapaties, curds + cucumber raita, an orange.

84. So the lesson on carbohydrates can be concluded by emphasizing the fact, already mentioned, that although carbohydrate rich foods are energy giving but at the same time, these should not be consumed in excess, to be free from the ill-effect, mentioned.
-

Response-Sheet

CARBOHYDRATES

Time : _____

Name : _____ Roll No. : _____

- | | |
|-------------------------|--------------------------------------|
| 1. _____ | 15. (a) _____ (b) _____ (c) _____ |
| _____ | (d) _____ (e) _____ (f) _____ |
| 2. (i) _____ (ii) _____ | (g) _____ (h) _____ |
| (iii) _____ | 16. _____ |
| 3. _____ | 17. _____ |
| 4. (a) _____ (b) _____ | 18. (a) _____ (b) _____ (c) _____ |
| (c) _____ (d) _____ | 19. (i) _____ |
| 5. _____ | (ii) _____ |
| 6. (i) _____ (ii) _____ | (iii) _____ |
| (iii) _____ (iv) _____ | 20. _____, _____ |
| 7. _____ | 21. a. (i) _____ |
| 8. _____, _____ | (ii) _____ |
| 9. _____, _____ | (iii) _____ |
| 10. _____ | b. (i) _____ |
| 11. (a) _____ | (ii) _____ |
| (b) _____ | (iii) _____ |
| (c) _____ | 22. (i) _____ (ii) _____ (iii) _____ |
| (d) _____ | 23. (a) _____ |
| (e) _____ | (b) _____ |
| 12. (a) _____ | 24. _____, _____, _____, _____ |
| (b) _____ | 25. (i) _____ (ii) _____ |
| (c) _____ | 26. _____, _____, _____, _____ |
| 13. _____ | 27. _____ |
| 14. _____ | 28. (1) _____ |
| | (2) _____ |

29. _____

30. (i) _____
 (ii) _____
 (iii) _____
 (iv) _____

31. _____

32. _____

33. (i) _____
 (ii) _____

34. _____

35. _____, _____, _____

36. (i) _____
 (ii) _____

37. (i) _____
 (ii) _____
 (iii) _____

38. _____

39. _____

40. _____

41. (i) _____
 (ii) _____
 (iii) _____
 (iv) _____

42. _____

Common Name	Chemical Name	Mono-saccharide in composition	Occurs in food group
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

43. Enzyme:

- (i) _____
 (ii) _____
 (iii) _____

44. (a) _____ (b) _____
 (c) _____

45. _____

46. _____

47. _____

48. (i) _____
 (ii) _____
 (iii) _____

49. (i) _____
 (ii) _____
 (iii) _____

50. _____, _____, _____
 _____, _____

51. (a) _____
 (b) _____
 (c) _____
 (d) _____
 (e) _____
 (f) _____
 (g) _____
 (h) _____
 (i) _____
 (j) _____

52. _____

53. _____

54. _____

55. (i)
(ii)
(iii)
(iv)

56. _____, _____

57. _____, _____, _____

58. _____

59. (i)
(ii)
(iii)
(iv)

60.

61. _____

62. _____

63. _____

64. (a) (i) _____
(ii) _____
(b) _____

65. _____

66. _____, _____, _____

67. _____

68.

69. (a)
(b)

70. (i)
(ii)

71. _____

72. (i)
(ii)
(iii)
(iv)
(v)
(vi)
(vii)
(viii)
(ix)

73.

74. _____

75.

76. _____, _____, _____

77. _____, _____

78. (i) _____
(ii) _____

79. (i) _____
(ii) _____

80.

81.

82. (a)
(b)

83. (a) (i)
(ii)
(b)

(Appendix B₃)

Programmed Learning Material

Unit III

FATS

So far we studied the two fuels, or the energy giving nutrients namely proteins and carbohydrates. The third fuel or the energy giving nutrient, we require, to be healthy, is the "fats", concerning which we will study the following points:

- i) Different kinds of oils and fats and their sources
- ii) Chemical composition of fats and oils
- iii) Physical properties and culinary uses of fats and oils
- iv) Difference between fats and oils
- v) Process of hydrogenation
- vi) Rancidity - different kinds
- vii) Deep frying and shallow frying methods
- viii) Nutritive value of fats and oils
- ix) Food sources of fats
- x) Ill effects caused by excessive consumption of fats and oils
- xi) Digestion and absorption of fats
- xii) Recommended allowance of fats
- xiii) Functions of fats

1. You must have definitely watched your mother or your aunty, daily frying varieties of food items like different parathas, cutlets, pattis and so many, such other delicious recipes for you. Haven't you?

Can you say in a word, generally which ingredient does she, first put into the frying pan, to begin frying?

Answer : Oil or cooking oil, or cooking fat

2. You may be knowing the names of just one or two cooking oils, but there are many edible cooking oils used in India. They are (i) Groundnut oil, (ii) Til or gingelly seed oil, (iii) Coconut oil, (iv) Soyabean oil, (v) Corn oil, (vi) Mustard oil, (vii) Sun flower oil, (viii) Cotton seed oil etc.; which are all known as vegetable cooking oils, as these are extracted from either oil seeds, nuts, pulse, corn, flower etc. which all belong to plant kingdom. For example groundnut oil, til oil, mustard oil, cotton seed oil are extracted from the respective oil seeds, coconut oil from the nut, soya bean oil from a pulse, corn oil from the corn and sun flower oil from the sun flower.

Knowing the sources of vegetable oils, you will be able to give the names of right oils, against the sources listed below.

<u>Sources</u>	<u>Names of Oils</u>
(i) Coconut	
(ii) Soyabean	
(iii) Sun flower	
(iv) Mustard seeds	
(v) Ground nut	
(vi) Gingelly seeds	
<hr/>	
Answer : (i) Coconut oils	(iv) Mustard oil
(ii) Soyabean oil	(v) Groundnut oil
(iii) Sun flower oil	(vi) Gingelly seed oil or til oil

3. Having studied the sources of all these cooking oils, you will now state the reason for the below mentioned sentence.

Groundnut oil, til oil, coconut oil and many such cooking oils are referred to as vegetable oils because

You are right if your answer is similar in meaning to the following:

these are extracted from oil seeds, nuts, pulse, corn, flower etc. which are all of the plant origin.

4. Besides all these vegetable oils, we also use some FATS for cooking. They are (i) butter (ii) pure ghee, (iii) lard (iv) tallow etc.. Some of these fats names are not familiar to you; right? So let us know the source from which each is obtained. Most of you must be knowing that butter can be obtained from milk and pure ghee from the butter on heating. In short butter and pure ghee are the milk-fats. Lard is extracted from pork-meat and tallow is obtained from beef or mutton.

Now, complete the following table by stating the right source, against the name of each fat.

Sr.No.	FAT	SOURCE
a)	TALLOW	
b)	BUTTER	
c)	LARD	
d)	PURE GHEE	

Answer : a) Beef or mutton, b) milk, c) Pork-meat, d) Milk

5. Fine! Now to be more thorough, let us recall and mention the right names of fats, for the sources of fats given below:

(i) Pork-meat	_____
(ii) Milk	_____
(iii) Beef or mutton	_____

Answer : (i) Lard, (ii) Butter or pure ghee, (iii) Tallow

6. You have noticed that these fats are extracted from either milk or from a kind of meat, which are animal foods.

Since cooking fats like butter, lard, pork and pure ghee are made from animal foods like milk or meat, these are referred to as _____ (animal/vegetable) _____ (oils/fats).

Answer : animal, fats

7. Both, the animal fats and vegetable oils are commonly called as 'fats' as they contain only one nutrient i.e. FAT. To be exact, the oils and fats, are entirely made up of only one nutrient namely, fat. They contain no other nutrient but fat.

Do you then agree that groundnut oil, til oil, pure ghee when taken in our diet, are capable of giving only one nutrient i.e. fat? (Yes/No)

Answer : Yes

8. The nutrient 'fat' is basically made of the same elements namely carbon, hydrogen, and oxygen as carbohydrates are made of. You will wonder, then what is the difference between carbohydrates and fats? The answer is; fat differs from carbohydrate in that, it contains much less oxygen and much greater proportions of carbon and hydrogen.

In simple words, carbohydrates and fats both are made of the same elements, namely, carbon, hydrogen and oxygen, but the proportion of these elements in both these nutrients is _____ (same/different).

Answer : different

9. Carbon, hydrogen and oxygen present in fats, together form Fatty acids and glycerol. These compounds serve as the basic units in the formation of fats. To be more correct, in each molecule of fat, three fatty acids are found attached to one molecule of glycerol.

Understand the chemical composition stated in the above paragraph and try to answer the following questions in words.

- (i) Which elements are present in the chemical composition of fats?
- (ii) What serves as the basic unit in the formation of fats?
- (iii) How many fatty acids are found attached to glycerol in a molecule of fat?

Answer : (i) Carbon, Hydrogen, Oxygen; (ii) Fatty acids and Glycerol; (iii) 3 fatty acids joined to glycerol.

10. Three fatty acids joined to a molecule of glycerol, is found in each molecule of animal fat as well as vegetable oil.

It may therefore be concluded that the chemical composition of both, the animal fats and vegetable oils is basically _____ (similar/different) as they are both composed of the same basic units, namely three fatty acids attached to a molecule of glycerol.

Answer : similar

11. All the fats and oils having the similar basic chemical composition, are also similar as far as their physical properties are concerned. To understand it better let us consider a simple example. Suppose you put a teaspoon of oil, in a bowl containing water. What will you see? You will observe distinctly, round, big and small droplets of oil, on the surface of water.

Since you find droplets of oil on the surface of water, you can say that oil is _____ (heavier/lighter) than water; and you also see the round oil droplets distinctly, which reflects that oil is _____ (soluble/not-soluble) in water.

Answer : lighter, not-soluble

12. Like oils, fats also have the same physical property. You know that butter can be separated from milk by first setting the milk into curds and then churning it. What happens on churning? The butter separates out on the top of the milk liquid called 'whey' which is nothing but water part of the milk.

Butter floating on top of whey, shows that fats are also _____ than water and also not _____ in water.

Answer : lighter, soluble

13. So we discussed two physical properties of fats and oils. They are:

- (i) _____
(ii) _____

Answer : (The order may differ)

- (i) Fats and oils are lighter than water.
(ii) Fats and oils are not-soluble in water.
-

14. Very Good! These fats and oils, having the same chemical composition and physical properties, also have the same culinary role which means they are used, mainly, for the same purpose in cooking foods, i.e. either to bring out flavour in the cooked foods or to produce good texture (i.e. tenderness) in the cooked foods or sometimes to achieve both flavour and good texture in a cooked food.

In short, the two main functions of fats and oils in cooking of foods can be summarized as:

(a) _____, and (b) _____.

Answer : (The order may differ)

(a) To bring out flavour; (b) To produce good texture.

15. You are now familiar with the main functions of fats and oils in cooking of foods. Try to guess the right function of fat or oil used for the following purposes. Write 'FLAVOUR', 'TEXTURE' or 'BOTH' against the following sentences; depending upon the function of fat or oil.

- (i) Oil used for doing vaghars _____
- (ii) Oil or fat added to chapati atta _____
- (iii) Oil or fat used for roasting masalas for vegetable, eggs or mutton curry _____
- (iv) Ghee used in preparation of sheera _____

Answer : (i) FLAVOUR; (ii) TEXTURE; (iii) FLAVOUR; (iv) BOTH

16. Fine! You are a good cook too! Any way, now, learning the chemical composition, physical properties and their functions in cooking of foods, you will conclude that both, the fats and oils are very _____ (different/similar) compounds.

Answer : similar

17. Although the fats and oils are similar in their chemical composition, physical properties and the functions in the food preparation. These are called differently as FATS and OILS. Certainly you must be wondering as to why these do not have one common name? - or what must be the difference between these two? If you will correctly answer the following question, you will yourself make out the chief basic difference between them.

Can butter or dalda ghee, as obtained from their, tins be poured from one container to the other, like the groundnut oil? (Yes/No)

Answer : No

18. Therefore, groundnut oil which can be poured from one container to the other is of _____ (thick/thin) consistency, whereas butter which cannot be poured as oils is, of _____ (thin/thick) consistency.

Answer : thin, thick

19. Thus, in general, you may say that the consistency of all oils is thin and that of the fats is thick, at room temperature.

It may therefore, be concluded, that the chief difference between fats and oils is that, fats are _____ (solid/liquid) while oils are _____ (solid/liquid) at room temperature.

Answer : solid, liquid

20. Oils are liquid and fats are solid at room temperatures because oils are unsaturated whereas fats are saturated compounds.

Learning the reason for the solid and liquid state of fats and oils at room temperature, complete the following statement.

Oils are liquid and fats are solid at room temperature because oils are _____.

Answer : unsaturated whereas fats are saturated compounds

21. You have already noticed earlier, that oils and fats are the compounds containing carbon, hydrogen and oxygen. In case of structure of oils all the four valencies of the carbon atoms are not satisfied and thus there are

double bonds existing between carbon atoms; which makes it very clear that oils are unsaturated compounds. On the other hand, in the structure of solid fats, all the four valencies of carbon atoms are satisfied and thus there are no double bonds existing. This reflects that fats are saturated compounds.

Having understood the above explanation concerning saturated and unsaturated nature of fats and oils respectively, tick (✓) mark only the correct statements from the following.

- (i) Dalda ghee is the unsaturated compound.
- (ii) Butter is a saturated fat.
- (iii) Saturated fats have thin pouring consistency.
- (iv) All the valencies of carbon atoms, in the structure of groundnut oil, are not satisfied.
- (v) Til oil is the unsaturated compound.

Answer : (ii) ✓ (iv) ✓ (v) ✓

22. It is very important to note here that unsaturated vegetable cooking oils can be converted to saturated fats. To understand this you should know, from what, the different vegetable ghees like Dalda, Rasda, Pakao, Lotus etc. (which are of course not pure ghee) are prepared. These ghees are prepared from vegetable oils.

Keeping the above fact in mind, answer the following questions very briefly; by writing 'Yes' or 'No' against each.

- (i) Can til oil be converted to solid ghee? _____
- (ii) Is it possible to produce saturated fats like different kinds of ghees, from unsaturated oils?

Answer : Yes, Yes

23. You are right! But are you not eager to know, how we get vegetable ghee from oil? Vegetable ghee is prepared from oil in factory, by adding HYDROGEN atoms to oil, which it can readily take up, since it is unsaturated.

In better words, any unsaturated oil can be converted into saturated ghee in the factory by the addition of _____ atoms.

Answer : hydrogen

24. The process by which, hydrogen atoms are added to unsaturated oils, is called the HYDROGENATION, and thus the ghee or fats manufactured by this process are called Hydrogenated ghees or hydrogenated fats.

Read the above information with concentration and answer the following questions only in words.

- (i) What is the name of the process by which hydrogen atoms are added to oils? Why it is called so?
- (ii) What can be hydrogenated oils or fats? Why?
- (iii) Which is the hydrogenated fat - pure ghee or dalda ghee?

Answer : (i) Hydrogenation - because hydrogen atoms are added.

(ii) Only oils - because they are unsaturated.

(iii) Dalda ghee

25. Very Good! So you know that dalda ghee is the hydrogenated fat, and many similar ghees are available in market. Would you not like to know what is the need for hydrogenating oils to produce such fats or ghees? One of the reasons is that some of the dishes, cannot be cooked or flavoured without ghee, and you already know that pure ghee which is prepared from milk is very costly. All people, thus, cannot afford to buy

pure ghee. Instead, the desired flavour of ghee is achieved by using the hydrogenated fats, which are available at cheaper rates compared to pure ghee. (for your information the present price of pure ghee is Rs.22 per one kilogram whereas that of hydrogenated fat is Rs.10/- per one kilogram).

Do you agree that some of the foods demanding use of costly pure ghee, can be economically prepared using cheaper hydrogenated fat? (Yes/No)

Answer : Yes

26. If your answer is 'Yes' to the above question, try and state atleast three names of the recipes which can be prepared using ghee.

(i) _____, (ii) _____, and (iii) _____.

Answer : (i) Sheera, (ii) Gulab Jamuns, and (iii) Malpura
(any such three recipes can be listed)

27. So you know that there are some food items, the preparation of which demand the use of ghee, in which case, hydrogenated fat, which imparts the flavour of ghee and which is quite cheaper compared to the pure ghee, can be used. Another reason why vegetable oils are hydrogenated is that, oils on long standing, develop a disagreeable flavour and thus become unfit for cooking; while if oils are hydrogenated and converted into fats, these would not spoil so soon as the oils; but instead keep fresh longer.

What is the advantage of hydrogenating oils to produce hydrogenated fats?

Answer : You are right if your answer is similar in meaning to the following:

The advantage is that they can be stored longer, without being spoilt.

28. We have so far discussed two reasons why oils need to be hydrogenated.

They are:

- 1.
- 2.

Answer : (The order may differ)

1. Because hydrogenated fats are cheaper compared to pure ghee and can be used in place of pure ghee which is very costly.
2. The shelf life or the storage period without becoming would be more, for hydrogenated fats, compared to oils.

29. You have just seen that oils, if stored for a very long time, develop a disagreeable flavour, which are then considered, as not fit for cooking. Such oils are termed as RANCID OILS.

Now, write only the number of the true statement.

- (i) Fresh oils are rancid oils.
- (ii) Stale or spoilt oils are rancid oils.

Answer : (ii)

30. In other words, oils which have been stored for a very long time and which fail to impart good flavour in the cooked foods are termed as _____ oils.

Answer : rancid

31. You may, therefore, state that oils become _____ if they are stored for a very long time, without being converted into _____ fats.

Answer : rancid, hydrogenated

32. Besides this, to be protected against rancidity, fats and oils, demand some extra care, in the way these are stored, to be used in future. They should be stored in a tightly closed containers in a cool dry place; otherwise the microbes or harmful organisms grow on them and make them rancid.

Learning the right way of storing fats and oils, if you find, your mother, storing ghee, in a jar, with a broken lid, in a corner of the kitchen, where even water pots are also stored, what will you advise her?

Answer : You are right, if your answer is similar in meaning to the following:

I would advise her to replace the lid of the jar which can be used to close the jar tightly, and not to store in moist area, and explain her further that if this is not done, unwanted harmful microbes will grow on it which will make it rancid.

-
33. Fine! The rancidity which develops due to growth of "microbes" on fats and oils, which are stored in open containers in moist place; is termed "Microbial Rancidity".

Having followed what 'microbes' are and what 'rancidity' is; define "Microbial rancidity" in a sentence.

Answer : You are right if your answer is similar in meaning to the following:

Rancidity caused due to growth of micro-organisms on fat and oils is called "Microbial Rancidity".

-
34. Another important point to remember about, the care to be taken during the storage period is; (i) fats and oils should not be contaminated with metals like iron,

copper etc. because if fats and oils come in contact with metals such as iron and copper, they are easily oxidized and thus become rancid.

Suppose your uncle who sells ghees and oils, stores plenty of these in big open copper barrels, with iron spoons, permanently in the barrels, for removing fats and oils - which are the two points, he needs to be instructed about? and why?

Answer : You are right if your answer is similar in meaning to the following:

I would instruct him to store ghees in some other containers rather than in copper or iron containers, and would also tell him not to use iron spoons, but instead steel spoons (or no spoons to be left in) because contamination of fats and oils with copper and iron, lead to their oxidation, which favours their rancidity.

35. Oxidation of fats and oils leading to their rancidity, is not only due to contamination with metals like iron and copper but also due to direct sunlight falling on them.

To sum-up, metals like copper and iron; and the natural factor called _____, are responsible for favouring rancidity by oxidation.

Answer : sunlight

36. Rancidity caused due to oxidation of fats and oils is termed oxidative rancidity.

Explain in a line what do you understand by oxidative rancidity?

Answer : (You are right, if your answer is similar in meaning to the following):

Oxidative rancidity is the kind of rancidity caused due to oxidation of fats and oils.

37. Having studied two kinds of rancidity namely microbial rancidity and oxidative rancidity, we shall now go on to understand the third kind of rancidity. Both oils, and fats become rancid, if these are repeatedly heated for the purpose of deep frying. This can be explained to you, in a better way by quoting a very familar situation here: Most of you are very fond of relishing freshly prepared Garam Garam Bhajia, standing at one of the shops in the market. Don't you? But have you even looked at the oil in the big deep frying pan at these shops? If you have seen that oil, you must have realized that it has a sort of, an off colour or dark greenish colour.

Do you think this is the natural colour of the oil? (Yes/No)

Answer : No

38. Correct! The oil or fat would lose its natural colour if the same lot of oil or fat is repeatedly heated. Such an oil or fat, the same lot of which, has been heated number of times, is rancid & generally toxic of poisonous. Even knowing this, shope keepers will not use fresh lot of oil or fat, every time, because these are quite costly items.

Getting this information, will you agree that the deep fried foods like kachories, patra, vada, bhajiyas etc; sold in the market are dangerous for our health and thus should not be eaten? (Yes/No).

Answer : Yes

39. If 'yes' is your answer for the above question, can you say, why, you should avoid such deep fried foods, sold in the market?

Answer : You are right if your answer is similar in meaning to the following:

Because the shop keepers use the same lot of oil or fat which then becomes poisonous or rancid which is dangerous for our health.

40. So you have followed that heating of same oil, and fat many times for frying purpose renders the fat and oil rancid. Moreover, even if fat and oils are OVER heated for the frying purpose, they turn rancid soon.

Hence, you can state that rancidity in oils and fats would develop, such, also due to _____ heating of oils.

Answer : over

41. Having realized the false ways of heating oils and fats which make them rancid point out the correct number of the phrase from the following which indicates presence of rancidity in the oils and fats.

(i) Over heated dalda; (ii) under heated groundnut oil; (iii) Til oil heated to the right temperature; (iv) Repeatedly heated soyabean oil.

Answer : (i) _/; (iv) _/

42. You certainly know that "repeatedly heated" fats and oils are rancid. Now let us learn what is 'over heating' of fats and oils. If you are used to cooking, you must have realized that when oil is heated in a deep frying pan, it reaches a temperature point, at which, it gives out blue visible fumes or smoke. The temperature at which any oil or fat begins to give out blue visible fumes is called the smoke point or smoking temperature any fat or oil.

Read the above information attentively to complete the following statement.

Smoke point or, smoking temperature of any fat or oil can be defined as the temperature point _____

Answer : at which it gives out blue visible fumes

43. Different oils and fats have different smoking temperature or smoke point.

Do you agree that butter and groundnut oil, when heated, in separate frying pans, would start to give out blue visible fumes at different temperatures?
(Yes/No)

Answer : Yes

44. If any fat or oil is heated above its smoking temperature or smoke point it is said to be over heated, in which case it gives out lot of smoke, and as you know this is a false practice of heating oil or fat, as it invites rancidity too soon.

Learning, what over heated fats and oils are choose the most correct response from the following:

Over heated fats and oils are those,

- (i) which are heated to the smoke point.
- (ii) which are heated above the smoke point.
- (iii) which are heated under the smoke point.

Answer : (ii) which are heated above the smoke point.

45. To understand how rancidity develops in the over heated fats and oils, we need to first concentrate on the changes that occur in the basic structure of fats and oils, when these are over heated. When any fat or oil is over heated, for the purpose of frying, it first

hydrolyses or breaks into its original components, fatty acids and glycerol. This glycerol further gets dehydrated to form a harmful poisonous substance called ACROLEIN; due to which the rancidity is quickened.

Read the above paragraph with concentration to understand thoroughly the chemical changes that take place in the basic structure of fats and oils when these are heated more than necessary; and then try to complete the following reaction showing the hydrolysis of factor oil, by adding the names of missing compounds.

Fat or oil over heated Fatty acids + _____
dehydrated

Answer : Glycerol, Acrolein

46. This acrolein formed on hydrolysis of fat, due to overheating, is found in the smoke, so produced.

In what do you find acrolein?

Answer : Acrolein is found in smoke

47. Acrolein found in the smoke, has a very sharp odour and is irritating to the mucous membrane of nose, throat and eyes. Therefore, if we stand near the overheated, smoking fat or oil, we would cough or our eyes would burn and water because the smoke contains acrolin, would enter into our eyes, and also nose along with the air, we breathe in.

Read the above paragraph, and use the below given words to fill in the gaps in the following statement:

Smoke, acrolein, overheat, respiratory.

It is not right to _____ the fat or oil, because on doing so, it hydrolyses, due to which a harmful substances called _____ is given out with the _____ which if inhaled, irritates the mucous membrane of the _____ tract as well as that of eyes.

Answer : overheat, acrolein, smoke, respiratory

48. You have observed that fats and oils, when overheated, hydrolysis or break into fatty acids and glycerole which gets dehydrated to form acrolein which make the fat unfit for cooking.

Do you agree that the rancidity also develops due to hydrolysis of fat, oil when over heated? (Yes/No)

Answer : Yes

49. You are right! Rancidity which develops due to hydrolysis of fat is called Hydrolytic rancidity.

Having collowed what is 'rancidity' and what is "hydrolysis" explain what is "Hydolytic rancidity" by describing in short, how fats spoil, when they are over heated.

Answer : You are right, if your answer is similar in meaning to the following:

On over heating, any fat or oil breaks down or hydrolyses into fatty acids and glycerol which further gets dehydrated into acroline, making the fat or oil rancid. The rancidity so developed, due to hydrolysis of fat is called hydrolytic rancidity.

50. The same kind of rancidity develops, even when the fats and oils are repeatedly heated.

If repeatedly heated fats and oils also become rancid due to hydrolytic rancidity, is it right to say that the same kind of chemical changes take place leading to acrolein formation in case of repeatedly heated fat and oils too? (Yes/No)

Answer : Yes

51. Thus, it is advisable that we should _____ (continue/avoid) overheating and re-heating of fats and oils, to keep them free of _____.

Answer : avoid, rancidity

52. We have so far discussed three kinds of rancidity.

They are: (i) _____ (ii) _____
(iii) _____

Answer : (The order may differ)

(i) Microbial rancidity; (ii) Oxidative rancidity;
(iii) Hydrolytic rancidity.

53. Very Good! You very well know the kinds of rancidity and the causes for each kind of rancidity. To have a complete set of names of rancidity and their causes; match words in (a) with the right words in (b), by only writing out the matching numbers of (a) with that of (B).

A	B
Names of Rancidity	Causes of Rancidity
1. Microbial rancidity is developed.	1. When fats & oils are exposed to sunlight or contaminated with metals like copper or iron.
2. Hydrolytic rancidity is developed.	2. When fats and oils are stored in open container in moist area.
3. Oxidative rancidity is developed.	3. When fats and oils are overheated or reheated many times.

Answer : (1) (2); (2) (3); (3) (1).

54. So you are thorough with the right ways of storing and using the fats and oils safely, which would help to avoid rancidity. Remember, rancid fats and oils render not only unacceptable flavour to the cooked products but also are not good for our health.

Therefore, we can conclude that to have good flavoured cooked foods and to be healthy, we must always use _____ (rancid/fresh) fats and oils.

Answer : fresh

55. Fresh oils and fats produce good flavoured products if these are fried satisfactorily.

Can you guess, how can satisfactory frying be helped? Tick (✓) the right alternative.

(i) By overheating the fat or oil; (ii) By underheating the fat or oil; (iii) By heating the fat or oil to right or optimum temperature.

Answer : (iii) ✓

56. Fine! Because the disadvantage of frying foods in overheated oil or fat is that it would burn the food from outside and let it remain raw or undone from within. Even underheating of the fats and oils fail to fry the food properly because if a food to be fried is left in the fat or oil, which is not heated enough, the food will take up more oil and thus become soggy and oily which is not at all acceptable, taste wise.

In other words, lower the temperature for frying _____ (lower/higher) is the fat absorption by the food, which would be then not at all palatable or tasty.

Answer : higher

57. Therefore when frying, food, fat absorption should be kept at _____ (minimum/maximum) for the sake of palatibility.

Answer : minimum

58. Minimum fat absorption by the fried food can be achieved by heating the fat or oil at the optimum temperatures, i.e. heating the fat or oil just to its smoking temperature and immediately leaving the food in it.

Learning the right way of frying the food, tick (✓) mark the correct limit to which a fat or oil, used for frying, should be heated from the following:

- (i) More than the smoking temperature or overheated.
- (ii) Less than the smoking temperature or underheated.
- (iii) Just to the smoking temperature.

Answer : (iii) ✓

59. You already know that different fats and oils have different smoking temperatures. Generally oils have higher smoking temperatures compared to fats. E.g. Groundnut oil, til oil etc. smoke at higher temperatures whereas dalda butter etc. smoke at relatively lower temperature.

Which one, of the two can be heated at high temperature.

Fat or Oils?

Answer : Oils

60. Or do you agree that fats having low smoke points cannot be heated to high temperatures, like the oils having smoke points can be heated? (Yes/No)

Answer : Yes

61. You are right! The fats having low smoke points cannot be subjected to high temperatures because they would then quickly burn away. For example butter having low smoke point cannot be used to fry snacks like kachori, bhajiya, vada etc. which need long frying at high temperatures, as it would burn very fast.

Instead, butter or any such fat can be used to fry an egg-omlette or puda which requires very _____ (short/long) frying time at _____ (low/high) temperatures.

Answer : short, low

62. To try snacks like bhajiyas, kachori etc. which need frying for the long time at high temperatures, we have to use oil only.

Read the above statement and select only the number of the correct alternative, which serves as a reason to the following statement.

"We have to use oil for the foods which need frying at high temperatures."

- (i) because oils have high smoke points, due to which they can withstand high temperatures for long time.
- (ii) because oils have low smoke points, due to which they can be heated to high temperatures for long time.

Answer : (i)

63. From the above discussion we can conclude that foods can be fried by two methods. They are (i) Frying at high temperatures for a _____ time and (ii) frying at low temperatures for a _____ time.

Answer : long, short

64. When foods are fried for a long time at high temperatures, a lot of oil is taken in a deep frying pan. This method of frying is called as "deep frying" method. But, when foods are fried on a shallow iron pan for a short time, at low temperatures using a little oil or fat at a time is called the "Shallow frying" method.

Understand the two methods of frying and state the differences between these two methods in terms of

- (i) Quantity of oil (more or less), used (ii) Kind of utensil used, (iii) High or low smoke point of fat or oil used and (iv) Time taken for frying (more or less).

	<u>Deep Frying</u>	<u>Shallow Frying</u>
(i)	(i)	
(ii)	(ii)	
(iii)	(iii)	
(iv)	(iv)	

Answer :	<u>Deep Frying</u>	<u>Shallow Frying</u>
(i)	More quantity of oil	(i) Less quantity of oil
(ii)	Deep frying pan	(ii) Shallow frying pan
(iii)	High smoke point	(iii) Low smoke point
(iv)	More time	(iv) Less time

65. Suppose a party is arranged on your father's birthday and your mother puts you in charge of frying the following foods. By which method will you fry, each of the following items?

- (i) Samosas; (ii) Potato chips; (iii) Vedmi;
(iv) Omlet; (v) Sago papādi

Answer : (i) Deep frying; (ii) Deep frying; (iii) Shallow frying; (iv) Shallow frying; (v) Deep frying.

66. Fine! Now you will be certainly able to say which sort of high or low, smoke point-oils or fats can be associated with the particular method of frying.

Make the two correct pairs out of the four following phrases and write out each pair on a line drawn below.

Deep frying, shallow frying, fats and oils of low smoke point : fats and oils high smoke point.

- (i) _____ and
(ii) _____.

Answer : (The order may differ)

- (i) Deep frying-fats and oils of high smoke point,
(ii) Shallow frying fats and oils of low smoke point.
-

67. Of course you know that in shallow frying very little fat is used, which is generally all taken up by food and hence no oil or fat is left behind. Contrary to this, for deep frying, we use lot of oil, only part of which is absorbed by the food and much is left behind. Very often the burnt particles of the food, fried in it, are found in the left over oils. The burnt particles should be strained out from the oil, before it is stored for the further use. Suppose you use the same oil second time, for frying, without removing the burnt particles, you will notice that it gets heated up much faster, than the clear fresh oil before. It also gives out smoke very soon.

What do you think is the cause for the re-heated oils with the burnt particles in it to release the smoke so fast?

Tick (✓) mark any one number of the following which serves as the right answer for the above question.

- (i) Because the smoke-point is lowered.
(ii) Because the smoke-point is raised.
(iii) Because the smoke-point is just reached.

Answer : (i) ✓

68. Very Good! Smoke point of any fat or oil is lowered, not only because of the presence of the unwanted burnt food particles in it, but also due to repeatedly heating of the oils and fats.

Hence we can also state that the two factors responsible for lowering the smoke-point of fats or oils are:

- (i) the presence of _____, and
- (ii) heating them _____.

Answer : burnt food particles, (ii) many times.

69. But as a matter of fact, and of course as you know the same lot of oils or fat should not be heated number of times, as it turns them rancid, which would be then, unfit for consumption. Certainly you are wondering if the lot of oil or fat, once used for deep frying, is not to be repeatedly used for the same purpose, then what is to be done with that big quantity of oil, left over? Definitely we cannot afford to throw away that oil, since, it is very costly. The answer is, it should be gradually finished by adding to chapatti-atta, or by using for vaghar, or for shallow frying.

After understanding the above point, suppose you find your mother, who is fond of fried foods, daily, frying puries and other things for lunch and dinner times, in the same lot of oil collected in the deep frying pan; what will you advise her?

You are right if your answer is similar in meaning to the following:

I would explain her to discontinue this unhealthy practice and advise her not to use the same lot of oil or fat, for deep frying again, instead to use it for vaghar or to add it to chappati or bhakhari atta, or to use it up for shallow frying.

70. You have advised your mother correctly! But you very well know that she loves to eat fried foods and therefore she includes some or the other fried foods in both the meals. Also to save her time and labour, she prepares puries instead of chapaties.

Having learnt that the fats and oils are totally made of the nutrient 'fat' - what do you think, would be the answer to the following question?

Will the daily consumption of fried foods increase the fat content of the daily diets? (Yes/No)

Answer : Yes

71. Right! Pure cooking oils and fats are completely made of the nutrient 'fat'. These do not contain any protein carbohydrates, minerals or vitamins except the hydrogenated fats like dalda, vanaspati, and such others, are enriched with vitamin A and D.

Read the above paragraph and complete the following table.

Nutritive value of groundnut oil.

- | | |
|-------------|---------|
| a) Protein | -- Nil |
| b) CHO | -- ____ |
| c) Fat | -- 100% |
| d) Minerals | -- Nil |
| e) Vitamins | -- ____ |

Answer : b) nil, e) nil

72. Having understood the nutritive value of cooking oils and fats answer the following questions in a word or two.
- (i) Can we rely on groundnut oil or butter present in our diets, for protein, carbohydrates, vitamins and minerals?

(ii) Which vitamins are added to hydrogenated fats or enrichment?

(iii) Which is the only nutrient that can be obtained from pure fats and oils?

Answer : (i) No, (ii) Vit.A and D, (iii) Fat.

73. Good! We get no other nutrient but only FAT from cooking oils and fats. These contain 100 percent fat i.e. you get 100 grams of fat from 100 grams of any cooking oil and hydrogenated fat like dalda pure ghee, etc.

Therefore you may state that the cooking fats and oils are concentrated or _____ (very poor/very rich) sources of fat.

Answer : very rich

74. So you know that 100 gms. of fat can be obtained from 100 gms. of any cooking oil or food.

How many grams of the nutrient, 'fat', your body can get from 25 grams of any fat and oil which is used to cook your full day diet?

Answer : 25 grams of fat

75. Besides pure fats and oils, we also get good quantity of fat from the foods like nuts such as almonds, cashewnuts, dry coconuts, gingelly seeds, ground nuts etc. These are referred to as RICH sources of fat.

All the nuts like groundnut etc. do not contain as much fat as cooking oils and fats and therefore these are called _____ (rich/very rich) sources of fat.

Answer : rich

76. Besides nuts, even eggs, milk-cream, cheese, mava and meat are also the rich sources of fat.

Which are the rich sources of fat besides nuts?

Answer : Eggs, milk-cream, mava, cheese, and meat are the rich sources of fat, besides the nuts.

77. You are now familiar with the rich sources of fats. Recall and write any seven rich sources of fat.

Answer : (The order may differ)

Groundnut, milk-cream; cheese, cashew nut, eggs, meat, almonds (any such other)

78. Cereals, pulses, fruits and vegetables are called as FAIR sources of fat as their fat content is very low.

Do you agree that cereals like rice, bajra, wheat, etc. pulses like greengram, lentil dry peas etc., leafy vegetables, carrot, radish, other vegetables and fruits like apple, banana, orange etc. are all fair sources of fat because these contain too little fat? (yes/No)

Answer : Yes

79. The foods which absolutely contain no fat are sugar, jaggery and honey. These are thus referred to as VERY POOR source of fat.

Having studied the names of some food which do not contain any fat complete the following statement.

Since the fat content of sugar, jaggery and honey is _____ (nil/100%) these are termed as _____ (very rich/poor) sources of fat.

Answer : nil, poor

80. You have learnt different kinds of food sources of fat. Read the list of the foods given below and write the most suitable adjective (VERY RICH, RICH, FAIR, OR POOR) against each name of the food mentioned below.

- | | |
|----------------------|-----------------------|
| (i) Cashew nut _____ | (vi) Eggs _____ |
| (ii) Sugar _____ | (vii) Greengram _____ |
| (iii) Rice _____ | (viii) Cabbage _____ |
| (iv) Butter _____ | (ix) Apple _____ |
| (v) Groundnuts _____ | (x) Til oil _____ |

Answer : (i) RICH, (ii) POOR, (iii) FAIR, (iv) VERY RICH,
 (v) RICH, (vi) RICH, (vii) FAIR, (viii) FAIR,
 (ix) FAIR, (x) VERY RICH.

81. Very Good! Now can you say, which set of meal can give more fat to your body, from the two sets of meals given below?

<u>Set I</u>	<u>Set II</u>
Rice	Egg curry
Tur dal	Fried rice
Chapaties	Mutter paneer bhaji
Ladies fingers	Parathas
Vegetables salad	Cashew nut burfi

Answer : Set II

82. Correct! If your daily meals consist of such fat-rich items in excess, you put on lot of weight because the extra fat consumed through diets, get deposited in your body; and become OBES or very fat.

Reading the above statement, tick (✓) mark for the most correct one of the following:

When too many fat-rich foods are daily included in your diets;

(i) Your body weight increases; (ii) The quantity of body-fat increases; (iii) The excess fat taken through meals accumulates in the body leading to an increase in the body weight, making the person obese.

Answer : (iii) ✓

83. Therefore, you may say that one of the ill-effects caused due to presence of more amounts of fat rich foods in daily meals, is obesity. The other ill effect of consuming large amounts of costly fats like butter, pure ghee etc.; and the fat-rich foods such as eggs, meat, milk products and nuts, daily, is that these lead to Heart Disease.

Read the above sentence and underline the words in it, that serve as an answer to each of the following questions.

- (i) Which foods affect the organ, that is situated between two lungs in our body?
- (ii) What is the exact name of the organ affected by these foods?
- (iii) Are these foods cheap or costly?

Answer : (i) butter, pure ghee, eggs, meat, milk-products, nuts., (ii) Heart, (iii) Costly.

84. Generally rich people who can afford costly fat rich foods suffer from _____ and _____ which are due to excess of fat deposition in the body on consumption of fatty foods.

Answer : obesity, heart disease

85. Heart disease can be avoided if the use of saturated fats like butter, pure ghee or dalda is restricted.

After learning the above mentioned fact from your teacher, what will you suggest to your grand father who has been reported a patient of hear disease and who relishes plenty of butter at the breakfast table?

Answer : You are right if your answer is similar in meaning to the following:

I would advise my grand father to discontinue eating so much butter daily because it is dangerous for the health of his heart.

86. If you are clear about which kind of fats are better for the health of heart your answer to the following question, would be right.

Who would have more physically healthy hearts -
Punjabies cooking their foods in varieties of ghee-s
or Gujaraties using groundnut oil or till oil to
prepare their foods?

Answer : Gujarati people

87. In other words Gujarati people use unsaturated fats to cook the food, while Punjabies use saturated fats for the same purpose.

Now can you say which kind of fats are good for the heart to be healthy - saturated fats or unsaturated oils?

Answer : Unsaturated oils

88. Then the obvious conclusion would be that vegetable _____ are better than the animal _____ or the hydrogenated oils.

Answer : oils, fats

89. So far we have discussed that we would not be healthy, if large amounts of fat rich foods and saturated pure fats are consumed daily. But to be healthy we definitely need some fat, either in the form of pure fat or as it occurs in natural foods.

Can we be healthy if we daily eat completely fatless meals? (Yes/No)

Answer : No

90. Then a question arises - how much fat should a person include in his full day diet? The answer is : "An adult person must have 25 gms, to 50 gms. of fat in the whole day diet.

Having studied the range of amount of fat, an adult daily needs, tick (✓) mark the right number of the correct range from the following:

- (i) 5 gms. to 25 gms.; (ii) 25 gms. to 50 gms.;
(iii) 50 gms. to 75 gms.; (iv) 75 gms. to 100 gms.

Answer : (ii) ✓

91. In better words the recommended allowance of fat is 25 gms. to 50 gms./adult/day. The quantity of fat taken through diet is first digested by the action of enzyme on it. Do you know the name of the enzyme that is required for the fat digestion? Perhaps not, don't worry. Read further and you will get the answer. The name of the enzyme which is necessary for the digestion of fat is STEAP SIN which is present in pancrease.

Answer the following questions, each in a word.

- (i) What is the name of the enzyme needed for fat-digestion?
(ii) Which body-organ has that enzyme?

Answer : (i) Steapsin, (ii) Pancreas.

92. Enzyme steapsin found in pancrease, hydrolyses or breaks the fat into fatty acids and glycerol.

What happens to the fat when it is acted upon by the enzyme steapsin?

You are right if your answer is similar in meaning to the following:

The fat hydrolyses into fatty acids and glycerol when acted upon by the enzyme steapsin.

93. In short, when the enzyme _____, found in pancreas, hydrolyses fats into _____ and _____, the fats are then said to be _____.

Answer : Steapsin, fatty acids, glycerol, digested

94. Very Good! The fatty acids and glycerol formed, on hydrolysis of fats, recombine to a considerable degree in the small intestine before absorption.

Study the above fact thoroughly and choose number of the most correct alternative consisting of all the points.

- (i) Small intestine is the organ where most of the fatty acids and glycerol, formed after the fats have been hydrolysed, join together before the absorption.
- (ii) Most of the fatty acids and glycerol formed on hydrolysis of fats, join together before absorption.
- (iii) Most of the acids and glycerol combine together after they have been digested.

Answer : (i)

95. But how do fatty acids and glycerol join? The answer is, three fatty acids join with a molecule of glycerol, as they are originally present in food.

Having studied how fatty acids and glycerol join, state which is the true statement.

- (i) Three glycerol molecules join to a fatty acid.
- (ii) Three fatty acids join with equal number of glycerol molecules.
- (iii) Three fatty acids join to a molecule of glycerol.

Answer : (iii) True

96. Each set of three fatty acids attached to a glycerol molecule, is termed a neutral fat.

Can you define in a line the term 'Neutral fat'?

You are right, if your answer is similar in meaning to the following:

Neutral fat can be defined as fat consisting of three fatty acids joined to a molecule of glycerol.

97. Correct! The neutral fats formed in the small intestine are then absorbed by the blood.

Study the above mentioned sentence and answer the following questions only in a word or two.

(i) Fats are absorbed in what form? (ii) Fats are absorbed from which organ? (iii) Fats are absorbed by what?

Answer : (i) Neutral fat form, (ii) Small intestine
(iii) Blood

98. Having noticed how fats are digested and absorbed, complete the below given statement by filling in the gaps.

The fats eaten are first digested or hydrolysed by the enzyme _____ into _____ acids and _____, which then recombine to form _____ fats which are absorbed from the small _____, by the _____.

Answer : steapsin, fatty, glycerol, neutral, intestine, and blood

99. Very Good! The fats absorbed by the blood are ready for carrying out many functions in the body. The main function of fat is to give energy to our body. You already know that one gram of either protein or carbohydrate when oxidized in the body releases 4 calories. Similarly when one gram of fat is oxidized in the body it gives off 9 calories, which is nothing but energy.

Read the above paragraph to complete the following statements:

- (i) Out of the three, protein, carbohydrates and fats maximum energy is derived from the ____.
- (ii) One gram of fat, on oxidation in the body release ____ calories.

Answer : fat, 9

100. You have observed that each gram of fat when oxidized in the body, is capable of giving 9 calories.

Suppose your afternoon meal consisted of 15 grams of total fat, how much energy or how many calories, your body would get from this quantity of fat. (Show your calculation)

Answer :	gm. of fat	Calories	
	1	-	9
	15	-	? 15 x 9 = 135 calories

101. Very Good! It is very clear to you that, like proteins and carbohydrates, fat also oxidizes or burns in the body to give heat or energy. We have discussed in the previous units that proteins and carbohydrates are the fuels of the body; because these burn to produce heat or energy in the body. Therefore we can say that fat is also a fuel for our body. Besides serving as a fuel give energy to the body, fats, also ~~save~~ serve as carriers of fat soluble vitamins namely A, D, E, K. In other words body can utilize vitamins in the presence of fat, since those are soluble in fat. Suppose you take absolutely fat-less diet. Will vitamins A, D, E, K present in your diet, be utilized by the body? Certainly these vitamins will not be effectively utilized by the body. And, if vitamin A, D, E and K are not utilized by the body because of absence of fat, many important

functions are not carried out in the body as a result we suffer from many physical disorders. The function of vitamin A is to keep the eyes healthy, that of vitamin D is to help the growth of bones and to keep them strong, that of vitamin E is to favour the process of reproduction and that of vitamin K is to help the co-gulation of blood, whenever it oozes out from the body through a cut or a wound. Suppose your different family members have the following complaints about their body. Which vitamin is not being utilized by each? State the name of the vitamin against each disorder stated below.

- (i) Your brother complains, "whenever there is any cut on the body, my blood does not stop flowing soon". _____.
- (ii) Your uncle says "I cannot see properly". _____.
- (iii) Your sister-in-law complains "when will I have a child"? _____.
- (iv) Your grand father reports: "My bones break very easily, even on a small fall". _____.

Answer : Vitamin K, Vitamin A, Vitamin E, Vitamin D.

102. Can you now say in brief, what is the ill effect caused if following vitamins body cannot make use of because of lack of fats?

Vitamin D	Vitamin E	Vitamin K	Vitamin A
-----------	-----------	-----------	-----------

You are right if your answer is similar in meaning to the following:

Vitamin D - Bones do not grow well and are not healthy.
 Vitamin E - One is not able to reproduce.
 Vitamin K - Blood does not co-agulate soon.
 Vitamin A - Eye-sight is poor.

103. Thus, it can be concluded that body must make use of fat soluble vitamins A, D, E and K, which is only possible if the nutrient called _____ is present, to carry them.

Answer : fat

104. Besides giving energy to our body and acting as a carrier for the fat soluble vitamins, fats are also needed to keep the skin healthy. Moreover fat prevents the early return of hunger since it remains in the stomach for a longer time than other nutrients. In other words, you wouldn't feel hungry soon, if your meal contains enough fat, or we feel satisfied for a long time with a meal, that has enough fat in it.

Which are the other two advantages of including fat in our daily diets?

Answer : 1) To keep the skin healthy
2) To remain satisfied without feeling hungry very soon.

105. Fine! So far we discussed four functions of fat. They are:

- (i) _____
 - (ii) _____
 - (iii) _____
 - (iv) _____
-

You are right if your answer is similar in meaning to the following:

- (i) To give energy to the body.
 - (ii) To carry fat soluble vitamins.
 - (iii) To keep the skin healthy.
 - (iv) To increase the satiety value of meals.
-

106. Right! You have realized the importance of fat in our meals. So we must include daily some fats containing foods in our meals. Contrary to this as discussed before, if our daily diets contain, more than necessary amounts of fat, after performing its functions, the extra fat, gets deposited in the body, making the person over-weight and very fat, which is the chief cause of many physical disorders leading to ill health.

Understanding the important functions of fat and the ill effects, that would be caused if it is taken in excess, what do you say....

(i) Fat should be present in enough quantity in our daily diets.

OR

(ii) We should live on completely fat less diet.

OR

(iii) Meals containing lot of fats should be consumed daily.

Answer : (i) Fat should be present in enough quantity in our daily meals.

Response-Sheet

FAT

Time: _____

Name: _____

Roll No.: _____

-
- | | | | |
|-----|----------------|-----|----------------------------------|
| 1. | | 18. | _____ , _____ |
| 2. | (i) (ii) | 19. | _____ , _____ |
| | (iii) (iv) | 20. | _____ |
| | (v) (vi) | | _____ |
| 3. | _____ | 21. | (i) (ii) (iii) |
| | _____ | | (iv) (v) |
| 4. | a) b) | 22. | (i) _____ (ii) _____ |
| | c) d) | 23. | |
| 5. | (i) (ii) (iii) | 24. | (i) |
| 6. | _____ , _____ | | (ii) |
| 7. | 8. | | (iii) |
| 9. | (i) | 25. | |
| | (ii) | 26. | (i) _____ (ii) _____ (iii) _____ |
| | (iii) | 27. | |
| 10. | _____ | 28. | (i) |
| 11. | _____ , _____ | | (ii) |
| 12. | _____ | 29. | |
| 13. | (i) _____ | 30. | _____ |
| | (ii) _____ | 31. | _____ , _____ |
| 14. | (a) _____ | 32. | |
| | (b) _____ | 33. | |
| 15. | (i) (ii) | 34. | |
| | (iii) (iv) | 35. | _____ |
| 16. | _____ 17. | | |

36. _____
37. _____
38. _____
39. _____
40. _____
41. (i) (ii) (iii)
(iv) (v)
42. _____
43. _____
44. _____
45. _____, _____.
46. _____
47. _____, _____,
_____, _____.
48. _____
49. _____
50. _____
51. _____, _____.
52. (i)
(ii)
(iii)
53. _____
54. _____
55. (i) (ii) (iii)
56. _____
57. _____
58. (i) (ii) (iii)
59. _____
60. _____
61. _____, _____.
62. _____
63. _____, _____.
64. Deep frying Shallow frying
(i) _____
(ii) _____
(iii) _____
(iv) _____
65. (i) (ii)
(iii) (iv)
(v)
66. (i) _____
(ii) _____
67. (i) _____ (ii) _____ (iii) _____
68. (i) _____ (ii) _____
69. _____
70. _____
71. (b) _____ (e) _____
72. (i) (ii) (iii)
73. _____
74. _____
75. _____
76. _____

77. _____
78. _____
79. _____, _____
80. (i) (ii) (iii)
(iv) (v) (vi)
(vii) (viii)
(ix) (x)
81. _____
82. (i) (ii) (iii)
83. (i)
(ii) (iii)
84. _____, _____, _____
85. _____
86. _____
87. _____
88. _____, _____
89. _____
90. (i) (ii) (iii)
91. (i) (ii)
92. _____
93. _____, _____, _____
_____, _____
94. _____
95. _____
96. _____
97. (i) _____
(ii) _____
(iii) _____
98. _____

99. (i) (ii)
100. _____
101. (i) _____
(ii) _____
(iii) _____
(iv) _____
102. Vitamin D
Vitamin E
Vitamin K
Vitamin A
103. _____
104. 1)
2)
105. (i)
(ii)
(iii)
106. _____

(Appendix C₁)
 Structured Lecture
 Unit I
 P R O T E I N S

So far we studied in details about the seven food groups. They are (1) Cereals (2) Pulses nuts and oil seeds (3) Fruits and vegetable (4) Milk and milk products (5) Sugar and Jaggery (6) Fats and oils; and (7) Flesh foods.

You already know that foods are made of nutrients. 'Proteins' is one of the nutrients, which is used as a fuel, by our body.

Related to proteins we will study the following points.

- (i) Origin of the term 'Protein'
- (ii) Meaning of the term 'Protein'
- (iii) Occurance of proteins in our body
- (iv) Chemical composition of proteins
- (v) Building up of proteins
- (vi) Kinds of amino acids
- (vii) Kinds of proteins
- (viii) Supplementary value of proteins
- (ix) Food sources of proteins
- (x) Varieties of proteins
- (xi) The recommended allowance of proteins
- (xii) Functions of proteins
- (xiii) Effects of deficiency of proteins; in growing children and adults.

(Teacher made maximum use of black-board while teaching each of the mentioned points.)

(i) Origin of the term protein:

The word protein has been originated from the Greek word 'Proteos'.

(ii) Meaning of the term protein:

Since the word protein has been originated from the Greek word 'Proteos' which means 'to be first', protein also means the same. Protein has 'to be first' supplied in our daily meals; compared to other nutrients. Why it is so important to have proteins first in our daily diets, you will understand from the next head line.

(iii) Occurance of protein in our body:

Proteins have to be taken first in our daily meals, because these are the indispensable constituents of every living cell. These are the essential components of both, the nucleus and the cell protoplasm and are found in most extracellular animal tissue fluids. The chief solid matter of heart, liver, kidney, brain, lungs, stomach, small and large intestines, the nerves blood cells, ligaments, cartilages, the walls of the blood vessels and the digestive tract, is proteins. These are the major components of bones and teeth too. Hair, nails, muscle tissues and skin consist almost entirely of proteins. In fact every living cell and all body fluids, except bile and urine are made of proteins. In short, proteins are so essential to all living cells as the basis of their structure and living matter, that life cannot exist without these.

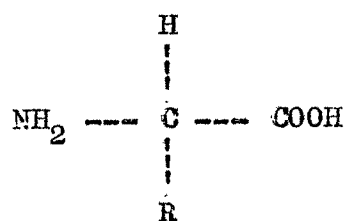
(iv) Chemical composition of proteins:

Proteins are composed of (1) Carbon, (2) Hydrogen, (3) Oxygen and (4) Nitrogen. Taking the first capital letter from these four constituents; you can also write in short that proteins are made of CHON. Proteins are also called as nitrogenous substances as they contain nitrogen.

(v) Building up of proteins:

Proteins are built of units called amino acids; which contain CHON and some other constituents. Just as bricks are required to build a wall, amino acids are needed to form or build proteins. In other words, amino acids are the building blocks of proteins.

The structure of an amino acid may be represented by the following formula.

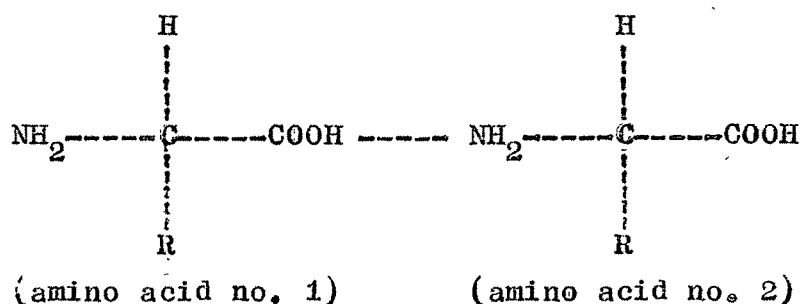


An Amino acid

Let us now study the formula in detail. You already know that a Carbon atom has four valencies. In the above formula, the four valencies of a carbon atom are satisfied by four different groups. The group on your left is NH_2 which is called as amino group or basic group. The group on your right is COOH which is called as acid group or carboxylic group. On the top is the hydrogen atom and R below represents the rest of the structure which is made of different components for different kinds of amino acids. At present you need not worry about what all R is consisting of, since at this elementary stage; it will be difficult for you to remember the lengthy formula of an amino acid. In short, an amino acid has a R, H, NH_2 (amino group) and COOH (acid group) groups. It can be concluded that an amino acid is so called because it has an amino group and an acid group.

Many amino acids have to join to build up a protein. Each two amino acids are linked together by a peptide linkage, in a protein molecule.

The proteins are built up when the amino group (NH_2 = basic) of one amino acid is joined to the acidic group (COOH = Carboxyl) of the other amino acid as shown below:



Remember, only unlike groups of amino acids join. Two same or alike groups of amino acids never join. In a protein molecule, hundreds or even thousands of amino acids are joined to one another by peptide linkage, where the amino group of one amino acid is linked to the Carboxyl group of the other amino acid. Whenever such a peptide linkage combines two amino acids into one single molecule, the resulting compound is a dipeptide. When three amino join together, the compound formed is a tripeptide. In the same way when four, five, six and seven amino acids join, the resulting compounds are called, tetra-peptide, penta-peptide, hexa-peptide and hepta-peptide, respectively. When more than seven amino acids join together, the compound formed is called as a polypeptide. An aggregate of polypeptides, in turn, is a complex protein.

In the same way as thousands of words are made from the twenty six letters of alphabet, so are thousands of proteins made of different combinations of amino acids.

(vi) Kinds of amino acids:

Considering nutritional importance, amino acids are classified into two main groups. They are : (i) Essential

amino acids, and (2) Non essential amino acids.

Essential amino acids:

Essential amino acids are so called because, these have to be essentially present in our daily diets, to keep healthy; as these are not synthesized by our body in sufficient amounts. These amino acids can be obtained from animal foods or non-vegetarian foods. Essential amino acids are ten in number: (1) Leucine, (2) Lysine, (3) Tryptophane, (4) Threonine, (5) Valine, (6) Iso-leucine; (7) Methionine, (8) Phenylalanine, (9) Arginine, and (10) Histidine.

Non essential amino acids:

These amino acids are called so because body can synthesize or make these amino acids, and hence these may or may not be present in our diet. These amino acids are present in plant foods or vegetarian foods. Non essential amino acids are five in number: (1) Glutamic acid, (2) Aspartic acid, (3) Alanine, (4) Proline, and (5) Hydroxy proline.

Strictly speaking, both the kinds of amino acids, the essential and the non essential, are essential for synthesis of body proteins.

(vii) Kinds of proteins:

Depending upon their ability to maintain life and promote growth, proteins have been classified as (1) Complete proteins, and (2) Incomplete proteins.

Complete proteins:

Proteins containing all essential amino acids in adequate amounts are called complete proteins or proteins of high biological value. Such proteins can maintain good health and support, maximum growth. As stated earlier, proteins of animal goods, i.e. meat, fish, poultry, liver and eggs are all complete proteins as they contain all essential amino acids in adequate amounts.

Incomplete proteins:

Proteins which are completely lacking in one or more essential amino acids are called incomplete proteins; or the proteins of low biological value. These are incapable of supporting growth as well as maintaining good health. Proteins of plant foods i.e. proteins of cereals, pulses, fruits, vegetables, nuts etc. are incomplete proteins, as they do not contain all the essential amino acids in enough amount.

We can thus conclude here that, compared to the incomplete proteins of plant foods, complete proteins of animal foods are of better quality, as they promote maximum growth and help to maintain optimum health.

(On the following day, students were taken to the laboratory for demonstration which was followed by the lecture on the next day.)

(viii) Supplementary value of proteins

You have realized that complete proteins keep you more healthy than incomplete proteins. You have also noted the food sources of complete and incomplete proteins. But it is not practical for most of the world's population to supplement incomplete plant proteins; with complete proteins, since eggs, meat, fish, poultry, liver etc. are very costly. Besides this many people are completely vegetarians. This does not mean that only non-vegetarian people are healthy. The fact that some vegetarians get along quite well, suggests that, all the amino acids can be made available to man, from plant foods alone if the right combinations can be found. It is important to note that proteins from two or more plant foods, if combined judiciously, these can make up, each others' amino acids deficiencies. For example cereals lack in lysine but have methionine, pulses are deficient in

methionine but are rich in lysine. Thus we can expect a combination of cereal and pulse to be better in nutritive value than either alone; as can be seen.

It can be noted from the below given example that supplementation of cereals with pulses significantly improves the nutritive value, which is reflected by the gain in the weight.

Weight gain of rats, fed on different diets

Experi- ment	Diet	Weight gain in four weeks (gms.)
I	Wheat	19
	Wheat + Bengalgram	31
II	Kodri	10
	Kodri + peas	39

Food and protein intake was the same in the different groups in each experiment.

If the protein of the diet is deficient in one or more of the essential amino acids and if another protein containing the missing amino acid in adequate amount, is added to the diet the nutritive value can be enhanced. This capacity of proteins to make good one another's deficiencies is known as their supplementary value of proteins.

(ix) Food sources of proteins:

According to the quantity and quality of proteins, there can be (1) Rich sources of proteins, (2) Fair sources of proteins, and (3) Poor sources of proteins. The food examples of three kinds of sources are listed below:

Rich source:- Eggs, fish, mutton, poultry, liver and milk.

Fair source:- Cereals, pulses, nuts, a few fruits & vegetables.

Poor source:- Sugar, jaggery, fats, oils. These have absolutely no protein.

(x) Varieties of Proteins:

Proteins from different food sources, are not alike. The protein in milk differ from protein in wheat because the number and kinds of amino acids used to make up these proteins are not the same. The proteins in the body also vary widely for the same reason and therefore, protein of the liver is unlike that of the muscles. Thus the proteins belonging to the different sources have different names.

The List of the examples is given below:

Sr. No.	Food Source	Name of the Protein
1.	Wheat	Gluten
2.	Maize	Zein
3.	Milk	Casein
4.	Meat	Myosin
5.	Egg	Albumin
6.	Pulse	Legumins

(xi) The recommended allowance (daily requirement) of proteins:

The recommended allowance for different individuals is different. The daily allowance of protein for Indians, recommended by the nutrition expert group, in 1968, is stated below:

Group	Protein(gms.)
Man	55
Woman	45
A child (7 years old)	33

From the figures stated above, it can be concluded that a man requires more proteins than a woman. The requirement of the proteins increases during the growth period. Thus it can be concluded that sex and age are the two factors which determine the recommended allowance of protein for an individual.

(xii) Functions of Proteins:

1. Promotion of Growth: Proteins in the diet supply amino acids required for the growth of young animals infants and children. Amino acids are used as building blocks to construct new body tissues throughout the entire growth period from the very beginning of life to complete the adult development. In the same way as new bricks are added when the house is being built. So are new proteins formed and added to the body structure throughout the process of growth. It is obvious then, that protein must be generously supplied in the diet during the entire growth period so that amino acids may be available for the building of body tissues.

2. To give energy to the Body: Protein also serves as a fuel giving energy to the body. The energy value of protein is measured, in terms of calories. Calorie is the amount of heat required to raise the temperature of one Kg. of water through one degree centigrade. When one gram of protein is oxidized in the body, it releases four calories.

3. Formation of important body constituents; like (i) Haemoglobin, (ii) Enzyme, (iii) Hormones, (iv) Antibodies.

Haemoglobin formation: 'Haem' is the iron and 'globin' is the protein. The iron bearing protein called haemoglobin which is present in red blood cells, performs a vital role in carrying oxygen to the tissues.

Enzymes formation: Enzymes which act as catalysts for metabolic reactions are protein in nature. The examples of enzymes are Pepsin, Trypsin etc.

Hormones formation: Hormones which are also protein substances, govern the body reactions. Examples of hormones are Insulin, Thyroid etc.

Production of anti-bodies: Proteins also form substances in blood known as anti-bodies which combine with bacteria, with toxins or with any other foreign material which reaches the blood, and dissolves it in a special fluid which they (anti-bodies) give off. This is how the anti-bodies, protect the health of our body.

Thus, the proteins are so essential that life cannot exist without them.

Effects of deficiency of proteins

Since protein is needed by both, growing children and adults, its deficiency in their daily diets, will affect the both severely.

(xiii) Effects of Protein deficiency in infants:

As you already know that protein supports growth, if it is not provided to infants during the weaning period (when the infants should be given semi solid, protein rich foods, along with milk), they would suffer from a disease called Kwashiorkor.

The protein deficiency disease Kwashiorkor, is studied under the headlines (1) Etiology of the disease, (2) Clinical features of the disease, (3) Therapy for the disease.

The meanings of all the headlines to study the disease are explained as follows:

Etiology: This includes the cause or causes of the disease since Etiology means "study of causation".

Clinical Features: This refers to the external signs on the body, from which a particular disease can be recognised.

Therapy: This means the treatment for the disease.

Kwashiorkor:

Etiology: Infants become victims of the disease, due to the protein deficiency in the weaning period. Two factors are responsible for the deficiency of proteins (i) poverty, and (ii) ignorance about nutrition. Either people have no money to afford costly protein rich foods; or people, even though they can afford to purchase protein rich foods, have no knowledge of nutritive value of foods. Some people wrongly believe that even semi solid preparations, made out of pulses, nuts and non vegetarian foods are very difficult for growing infants and children to digest. Generally rice, sago, potato, yam, bananas and other sweet preparation containing sugar and jaggery, which are carbohydrate rich foods, are only used as weaning foods. These are definitely low in protein content. The sole use of such protein-poor foods for growing infants, leads to the disease Kwashiorkor.

Clinical Features:

- (i) **Failure to grow:** The child's weight is usually much below the standard, for his age but real weight is marked by Oedema. Oedema is the condition in which the water accumulates in the body; in the place of protein.
- (ii) **Changes in hair:** The hair becomes lusterless and sparse. It loses its curl and becomes straight. Kwashiorkor children may show a variety of pigmentary change i.e. the hair becomes either brown, grey or straw coloured.

- (iii) Mental apathy: A Kwashiorkor child is a cry baby. He takes no friendly or lively interest in surroundings. Any attempt to arouse his interest results in only making him cry. He is extremely irritable.
- (iv) Changes in the skin: Depigmentation in skin occurs. Sub-cutaneous fat is lost gradually.
- (v) Poor digestion: Vomitting occurs and there is often a distressing diarrhoea; with the passage of stools, containing much undigested food.

Therapy:

- (i) A well balanced diet with a high and complete protein content is necessary. Proteins of best quality (complete proteins) include eggs, meat, fish, poultry, milk and milk products.
- (ii) Plant protein mixtures (supplemented proteins) can be used so that quality of protein used is better e.g. Khichdi, Idlies, etc.
- (iii) Banana milk diet is advised:
Ingredients: 400 gms of sweet bananas, 200 gms of milk;
70 gms of sugar; 300 ml. of water.

These ingredients are thoroughly mixed and the mixture is divided in eight parts and fed during the day. Severe Kwashiorkor case must be treated under medical supervision.

If the diet lacks in enough quantity and good quality of protein over a period of time, an adult becomes a victim of the following effects.

- (i) Muscles lack tone and may become soft and flabby.
- (ii) Nails break easily.
- (iii) Hair will lose luster and become sparse.
- (iv) Red blood cells which contain haemoglobin, are not produced in sufficient numbers, to supply the body

with oxygen it needs. As a result inefficiency and lack of energy to work would follow.

- (v) Infection sets in because antibodies are not produced in sufficient quantity. Thus the liability to destroy bacteria is greatly decreased.
- (vi) Digestive enzymes decrease, both in ^{quantity} ~~number~~ and in effectiveness; which causes the food to be less completely digested.

If you wish to be attractive and healthy; and remain so throughout the years to come, see that your diet supplies ample proteins of good quality.

(Appendix C₂)
Structured Lecture
Unit II
CARBOHYDRATES

In the last unit you finished studying about the important energy giving fuel used by our body namely proteins. Besides proteins, carbohydrates are also used as a fuel, to gain energy by our body. We will study the following points concerning carbohydrates.

- (i) Chemical composition of carbohydrates.
- (ii) Meaning of the term 'Carbohydrate'.
- (iii) Process of photosynthesis.
- (iv) An important function of carbohydrates.
- (v) Recommended allowance of carbohydrates.
- (vi) Sources of carbohydrates.
- (vii) Kinds of carbohydrates, including their properties, food-sources and digestion.
- (viii) Diabetes - the ill-effect due to excessive consumption of carbohydrates.

(Teacher made maximum use of black board while teaching each of the mentioned points)

(i) Chemical composition of Carbohydrates:

It has been already made clear through the previous lesson, that proteins are made of carbon, hydrogen, oxygen and nitrogen. Carbohydrates are made of only the first three, i.e. carbon, hydrogen and oxygen. Thus in short we can say that carbohydrates are made of CHO.

(ii) Meaning of the term Carbohydrate:

The term carbohydrate is the combination of two words, carbo and hydrates. 'Carbo' stands for carbon atoms and 'hydrates' indicates that generally hydrogen atoms and oxygen atoms are present in the proportion of two hydrogen atoms to one oxygen atom so as to form water - H_2O ; and from this fact, the term Carbohydrate was derived.

(iii) Process of photosynthesis:

This is the process by which plants prepare their own food. The green colouring matter in the plant leaves called chlorophyll utilizes water of the soil, carbondioxide of the atmosphere and synthesizes carbohydrates (which is the food for plants) in the presence of sunlight. It can be thus concluded that chiefly four things are needed by the plants to prepare their own food - namely (i) Chlorophyll, (ii) water, (iii) carbondioxide, and (iv) sunlight. The word photosynthesis is made of two words 'photo' and 'synthesis'. 'Photo' means 'light', and 'synthesis' means 'to make'. Therefore the full word photosynthesis means 'to make something in the presence of light'. As just told, the plants do need sunlight to prepare their food; we can say that photosynthesis is impossible at night when there is no sunlight.

This process of photosynthesis is very important for continuance of life on this earth; because the carbohydrates, prepared by this process are stored in the plants and are utilized by the human beings and plant-eating animals, as the chief source of energy.

(iv) An important function of Carbohydrates:

The main function of carbohydrates is to give energy. It is very clear that like proteins, carbohydrates also have to burn or get oxidized in the body to produce heat which is

nothing but calories or energy. It is very important to know that one gram of carbohydrates when oxidizes or burns in the body, gives 4 calories.

(v) Recommended allowance of Carbohydrates:

The recommended allowance of carbohydrates is roughly 350 grams per day per an adult person. This quantity is enough to achieve the necessary energy for a day's energy. Since one gram of carbohydrates gives 4 calories, as explained before, 350 grams of carbohydrates on oxidation in the body will produce $350 \times 4 = 1400$ calories.

(On the following day, students were taken to the laboratory for demonstration which was followed by the lecture on the next day.)

(vi) Sources of Carbohydrates:

Carbohydrates are found in most of the foods in more or less quantities.

(a) Concentrated sources of the very rich sources of carbohydrates:

Sugar and jaggery are the concentrated or the richest sources of carbohydrates as they contain 99.4% and 95% of carbohydrates respectively. But we do not use them as much as we use the other foods, as they are the only sweetening agents.

(b) Rich sources of carbohydrates:

Cereals like rice, wheat, bajra, jowar containing about 65% to 70% of carbohydrates and which form the bulk of Gujaratis' daily diets, are rich sources of carbohydrates. Besides cereals we also get good quantity of carbohydrates from root vegetables, in our daily meals. These are also the rich sources of carbohydrates.

(c) Fair sources of carbohydrates:

Peas, nuts and oil-seeds which contain considerable amounts of carbohydrates are next important sources of carbohydrates. Amongst fruits, sweet fruits contain moderate amounts of carbohydrates. Leafy vegetables, other vegetables and citrus fruits are very low in their carbohydrate content.

(d) Poor sources of carbohydrates:

Fats and oils are the foods which absolutely contain no carbohydrates. Therefore these are termed the poor sources of carbohydrates.

(vii) Kinds of carbohydrates:

Different kinds of carbohydrates having significance in nutrition are broadly classified into three main groups. They are (i) Monosaccharides, (ii) Di-saccharides and (iii) polysaccharides.

Monosaccharides are the simple sugars. Mono means one and saccharide means sugar, therefore mono-saccharide completely means one-sugar, but it precisely means a simple sugar. Mono-saccharides are called the simple sugars because they contain just one molecule of sugar. Di-saccharides are the double sugars. 'Di' means two and 'saccharide' means sugars. So 'Di-saccharide' fully means two sugars. Each di-saccharide is made of two simple sugars or two monosaccharides. Poly-saccharide means a multiple-sugar, since 'poly' means many and 'saccharide' means sugar. Polysaccharide is called a multiple sugar because it is formed of many molecules of mono-saccharide.

Mono-saccharides:

The examples of mono-saccharides are (i) Glucose, (ii) Fructose, and (iii) Galactose.

These three mono-saccharides have two common properties, i.e. (i) they are all soluble in water, and (ii) they are not affected by the digestive enzymes, which means these do not undergo any digestion since these are simple sugars.

(i) **Glucose:** It is sweet in taste. It is found in most of the fruits, vegetables and in immature cereals.

Besides these food sources, glucose is also found in our blood. It is therefore that the glucose is also called blood-sugar. The normal blood level of glucose is 80 mgs. to 90 mgs. per every 100 ml. of blood. Sweet glucose powder available on the market is given to sick people to get energy, because it is readily absorbed and utilized by our body.

(ii) **Fructose:** It is a very sweet kind of carbohydrate, sweeter than glucose also. It is about 2.5 times sweeter than glucose. It is mainly found in sweet ripe fruits, honey and vegetables. It being a simple sugar does not undergo digestion, but it is utilized by our body, only after being converted to glucose.

(iii) **Galactose:** It does not occur alone in nature, but it is found in milk combined with glucose to form milk-sugar. So the source of galactose is the animal food namely the milk.

Di-saccharides:

The examples are, (i) Sucrose, (ii) Maltose, and (iii) Lactose.

(i) **Sucrose:** It is the sweet table-sugar we daily put in our tea, coffee or milk. It being a di-saccharide, is formed of two mono-saccharides namely glucose and fructose. Sucrose is called the fruit sugar because it is found in sugar-cane and other sweet fruits. Beet-root is also a good source of sucrose. Sucrose or table-sugar is

generally made from sugar-canes and beet-roots. It is 1.5 times sweeter than glucose.

(ii) Maltose: It is called so because it is found in malted cereals. It is also referred to as cereal-sugar. It is a disaccharide made of two mono-saccharides namely two units of glucose.

(iii) Lactose: It is also formed of two mono-saccharides namely glucose and galactose, as it is a disaccharide. Lactose is found in milk; and therefore it is also called milk-sugar.

Poly-saccharides:

Some of the poly-saccharides having importance in nutrition are (i) Starch, (ii) Glycogen, and (iii) Cellulose. These have two common properties; one of the properties is that, all these polysaccharides are not soluble in water and the other is that these are not at all sweet. A few facts about each of these three polysaccharides are given below.

(i) Starch: This is the most common polysaccharide consumed by the human beings and the animals. It is formed of many molecules of glucose. The chief foods which contain starch are cereals such as rice, wheat, maize etc. and the root vegetables, such as potatoes, sweet potatoes etc. In short cereals and root vegetables are the rich sources of starch.

(ii) Glycogen: Like starch, glycogen is made of many many glucose units. Therefore we can say that starch and glycogen have the same chemical composition, i.e. both are made of many glucose units. But they differ in the source they belong to. Like starch, glycogen is not found in any food, but it is made in our body, from the extra glucose, whenever our body has some more glucose, which it

does not need, it is converted into glycogen which is then stored in the liver and muscle tissues. Whenever the dietary supply of carbohydrates is inadequate, the glycogen stored in the liver gets easily converted to glucose which can be used by the body as the immediate source of energy. Besides the amount of glycogen stored in the liver is more than that stored in the muscle tissue. Therefore liver is the principal store-house of glycogen which is used as the source of energy by the body. In short we conclude that starch and glycogen differ in their sources, but are similar in their chemical composition. Therefore glycogen is also referred to as animal starch.

(iii) Cellulose: It is not utilized by our body as the source of energy as the starch and glycogen are utilized. It is only thrown out of the body, unused as a waste through faeces, because it is not digested in our body. Cellulose is not digested in our body because our digestive system lacks the enzyme called cellulase which helps in the digestion of cellulose. Plant eating animals can digest grass which contains a lot of cellulose because their digestive system has the enzyme called cellulase. Cellulose is found in the non-edible portions of the plant foods like peels of fruits and vegetables and in the skin or outer coatings of the cereals. Although it is not digested, it offers a valuable service, by forming a bulk which helps the bowel waste to be voided regularly thus preventing the tendency to constipation. Therefore though cellulose does not improve the nutritive value of our food - or though we do not use it as the source of energy, like we use the other carbohydrates, we must include cellulose containing foods in our daily diets, as they help in the elimination of the bowel waste. An important point to note here is that the two polysaccharides which do not undergo digestion are glycogen and cellulose and the one which has to undergo digestion before being utilized, is the starch.

Digestion:

It has been made clear that all the mono-saccharides being simple sugars do not undergo digestion. Amongst polysaccharides glycogen and cellulose too do not undergo digestion. Contrary to this, all the di-saccharides being double sugars and starch being a multiple sugar, have to be broken down into simple sugars before being utilized by the body. In other words all the di-saccharides and a polysaccharide namely starch undergo digestion.

Digestion of di-saccharides:

Sucrose: Sucrose is acted upon by the enzyme sucrase which breaks it into glucose and fructose, the two mono-saccharides which it is originally formed of.

Maltoes: Maltose is broken down by the enzyme maltase, into two units of glucose, the mono-saccharide units of which it is originally made of.

Lactose: Lactose is broken down by the enzyme lactase into glucose and galactose, the two mono-saccharides of which it is originally composed of.

This digestion of the di-saccharides occurs in small intestine.

Digestion of the polysaccharide:

Starch: Starch is digested at two sites, one in the mouth and second in the pancreas when we chew the food, it mixes with the Saliva which has an enzyme called Ptylin. This Ptylin acts on some of the cooked starch and breaks it into maltose i.e. a pair of two glucose units. Whatever cooked starch or uncooked starch that has escaped digestion in the mouth is digested in the pancreas by the enzyme Amylopsin, which also breaks it into maltose. The maltose thus obtained by the action of either ptylin in the mouth or by amylopsin in the pancreas, is broken down into glucose

and glucose by maltase, further in the small intestine. Thus we get many glucose units from the digestion of starch because it is originally made of many glucose molecules. The glucose thus formed is absorbed and utilized as the source of energy. Monosaccharides other than glucose either as such present in our food, or those formed during digestion, are all converted first into glucose which is then absorbed, by the blood, and then utilized by the body.

(viii) Diabetes:

Suppose some of the glucose formed in the body from the carbohydrates present in our foods, is not utilized by the body, it will collect in the blood. The blood will then have more and more glucose being collected into it, i.e. blood will have much more glucose than what it would have normally. There are two causes for the increased blood level of glucose. One of the reasons is, if the hormone, insulin which helps the utilization of glucose is not secreted in enough quantity, and the other reason is if too much of carbohydrates containing foods are consumed daily, then also more and more quantity of glucose will be formed which will collect in the blood. In other words if daily eat root vegetables, cereals and sweet dishes prepared out of sugar and jaggery in excess, the glucose will also be formed in excess and thus whatever extra glucose which will not be utilized by our body, will pile up, or will gather in the blood. But there is a limit to the quantity of glucose which blood can hold. If the blood is analysed in the laboratory half an hour after the meal is taken, the quantity of glucose in the blood, is found to be more, or the level of the glucose in the blood rises i.e. the glucose concentration goes higher than 80 to 90 mgs. per every 100 ml. of blood, depending upon the carbohydrate content of your food. Blood can hold glucose maximum upto 140 mgs.

to 150 mgs. of glucose for every 100 ml. of blood. It generally cannot hold more than this. It is then thrown out of the body via urine. Presence of glucose in the urine is the sure sign of the disease diabetes. The other method of detecting the presence of diabetes is by analysing the blood for its glucose content. If the glucose level of blood remains approximately 140 to 150 mgs. of glucose per every 100 ml. of blood constant, for more than three hours, it is also a certain sign of diabetes. Diabetes is such a disease which cannot be controlled to an extent. As nutritionists we can control the disease by the use of right foods. One of the reasons for the occurrence of diabetes is the daily consumption of too much of carbohydrates rich foods, which has been already explained before. Therefore to control diabetes partially, the patient must avoid sweet foods like cakes, puddings, custards, jellies, jams, chocolate, chikies, chewing gums, sweet drinks like coca cola, fanta, sherbats, cordials, sweet fruit juices etc. Besides these, cereals like rice and root vegetables like potatoes and sweet potatoes etc. should be avoided. Fried foods are also to be avoided as it is very necessary to control the body weight, when one suffers from diabetes. To be on safe side, a diabetic patient must eat a low calorie diet including plenty of other vegetables and leafy vegetables, sprouted pulses, fermented foods, boiled eggs and meat, curds and citrus fruits.

So the lesson on carbohydrate can be concluded emphasizing the fact the richest and the rich food sources of carbohydrates are energy giving no doubt, but at the same time if consumed in excess are health spoiling.

(Appendix C₃)
Structured Lecture
Unit III
FATS

So far you studied about the two important fuels or energy giving nutrients namely proteins and carbohydrates. Fats are the third kind of maximum energy giving nutrients. You know that 'Fats' is one of the seven food-groups we studied earlier. Concerning fats we will study the following points.

- (i) Different kinds of edible fats and oils; and their sources.
- (ii) Chemical composition of fats and oils.
- (iii) (a) Physical properties, and (b) Culinary uses of fats and oils.
- (iv) Difference between fats and oils.
- (v) Process of hydrogenation.
- (vi) Rancidity - Different kinds of rancidities.
- (vii) Deep frying and shallow frying method.
- (viii) Nutritive value of fats and oils.
- (ix) Food sources of fats.
- (x) All effects caused by excessive consumption of fats and oils.
- (xi) Recommended allowance of fats.
- (xii) Digestion and absorption of fats.
- (xiii) Functions of fats.

(Teacher made maximum use of black board while teaching each of the mentioned points.)

(i) Different kinds of fats and oils - with their sources:

<u>The names of the edible fats</u>	<u>Sources</u>
1. Butter	Milk
2. Pure Ghee	Milk
3. Lard	Pork meat
4. Tallow	Beef or mutton
5. Dalda, Vanaspati etc.	Vegetable oils

The sources for the first four fats, are all from animal kingdom and therefore the four fats namely butter, pure ghee, lard and tallow are all referred to as animal fats. On the other hand, fats like dalda, vanaspati etc. which are prepared from vegetable oils, are referred as vegetable fats.

<u>The names of edible oils</u>	<u>Sources</u>
1. Ground nut oil	Ground nuts
2. Gingelly seed oil (til oil)	Gingelly seeds
3. Coconut oil	Coconut
4. Soyabean oil	Soyabeans
5. Corn oil	Corns
6. Mustard oil	Mustard seeds
7. Sunflower oil	Sunflowers
8. Cotton-seed oil	Cotton-seeds

The sources for all these oils are from vegetable (plant) kingdom. Therefore these are referred to as vegetable oils.

(ii) Chemical composition of fats and oils:

The fats and oils which are commonly called as 'fats' as they are entirely made of only one nutrient namely fat. This nutrient fat is basically made of the same elements i.e. carbon, hydrogen and oxygen as the carbohydrates are made of. You will wonder then what is the difference between carbohydrates and fats? Fats contain much less oxygen and much greater proportions of carbon and hydrogen; as compared

to carbohydrates. In short the proportion of carbon, hydrogen and oxygen is not the same for fats and carbohydrates. Carbon, hydrogen and oxygen present in fats together form fatty acids and glycerol. These compounds together serve as the basic unit in the formation of fats. To be specific, in each molecule of fat, present either in animal fat or vegetable oil, three fatty acids are found attached to one molecule of glycerol. This reflects that all the fats and oils have the similar basic chemical composition.

(iii) a. Physical properties of fats and oils:

Fats and oils having the similar basic chemical composition, also have the same physical property. The two common physical properties are (i) fats and oils are lighter than water, and (ii) fats and oils are immesible in water. To prove these properties, put a tea-spoon of either butter or any cooking oil, in a pot containing water, you will find that butter is separately seen on the surface of water and you will also observe distinctly round big and small deparate droplets of oil, on the surface of water. This shows that fat is lighter than water since it floats on its surface; and that fat is immissible in water.

(iii) b. Culinary uses of fats:

The fats and oils having the same basic chemical composition and same physical properties also have the same culinary role; which means they are used for the same purposes in the kitchen; for cooking the foods. Fats and oils are used either to bring out flavour or to produce good texture; in cooked foods. For example oil or ghee is used for making vaghars, in which case the purpose is to bring out or increase the flavour. Oil or fat added to chapati atta chiefly helps to produce good texture in the final product; whereas oil used for making upma or ghee used for making sheera helps both; the texture as well as the flavour of the cooked product.

(iv) Difference between fats and oils:

Although the fats and oils have the same chemical composition, same physical properties and the same sort of culinary role, these do not have one common name. These are called differently as 'fats' and 'oils'. This is because of the reason that fats are solid at room temperature whereas the oils are liquid at room temperature. But why so? This is again because of the reason that oils are unsaturated, while the fats are saturated compounds. This reflects that in structure of oils all the four valencies of each carbon atom are not satisfied and thus these are double bonds existing between carbon atoms. Therefore oils are liquid at room temperature. In case of structure of fat, all the four valencies of each carbon atom are satisfied and hence there are no double bonds existing. This shows that fats are saturated compounds which are therefore solid at room temperature.

(v) Process of hydrogenation:

It is very important to note here that unsaturated vegetable cooking oils can be converted to saturated cooking fats. It has been already mentioned before that cooking oils can be converted to cooking fats like dalda, vanaspati, rasada, lotus, pakao, etc. But how? These vegetable ghees are prepared from oils in the factory by a process called hydrogenation. This is the process in which hydrogen atoms are added to unsaturated oils to convert them, into saturated ghees or fats. Such vegetable ghees prepared by the process of hydrogenation are called hydrogenated fats. But a question arises what is the need for converting vegetable oils into hydrogenated ghees? The answer is : one of the reasons is that some of the dishes, cannot be cooked or flavoured without ghee, and pure ghee which is prepared from milk, is very costly. All people, thus, cannot afford to buy pure ghee. Instead the desired flavour of ghee is

achieved by using the hydrogenated fats which are available at cheaper rates compared to pure ghee. (The cost of pure ghee is Rs.22 per kg. and that of hydrogenated fat is Rs.10/- per kg.) The other reason why vegetable oils are hydrogenated is that, oils on long standing, develop a disagreeable flavour and thus become unfit for cooking, while if oils are hydrogenated and converted into fats, these would not spoil so soon as the oils; and can be stored for a longer time without becoming stale.

(vi) Rancidity - Different kinds of Rancidities:

The oils and fats develop disagreeable flavour when they spoil or become stale. Such spoilt or stale oils and fats which are not fit for cooking are called rancid oils or rancid fats. We can also say that "rancidity" develops in fats and oils.

Kinds of rancidities: There are three kinds of rancidities.

They are (i) Microbial rancidity,
(ii) Oxidative rancidity, and (iii) Hydrolytic rancidity.

Microbial rancidity: To be protected against rancidity, fats and oils, if stored, to be used in future, they should be stored in tightly closed containers in a cool dry place; otherwise the microbes or the harmful organisms grow on them and turn them rancid. Therefore, rancidity which develops due to growth of microbes on fats and oils, stored in open containers in moist places, is termed microbial rancidity.

Oxidative rancidity: Another important point to remember, about the care to be taken, during the storage period, is that, fats and oils should not be contaminated with metals like copper and iron, because if they come in contact with these metals, they get oxidized. Therefore these should not be stored in iron or copper containers, or that even iron or copper spoon should not be

left permanent in fats and oils. Oxidation of fats and oils, also occur if the direct sunlight falls on them. Therefore, these should not be stored in open containers, in the places, where the sunlight can directly attack them; otherwise they would be oxidized and become rancid. The rancidity caused due to oxidation of fats and oils, is called oxidative rancidity.

Hydrolytic rancidity: Both fats and oils become rancid, if these are repeatedly heated. A very familiar example to quote here is, the bhajiyas being fried for days together, in the same lot of oil at the market shops. The colour of such an oil which is repeatedly heated is also not natural. Such an oil is a rancid one and is generally toxic or poisonous, and therefore not at all good for our health. Shopkeepers never use the fresh lot of oil, each time they fry because oils are very costly. We should avoid eating the products fried in such oils.

Oils and fats also become rancid if they are over heated. Now let us understand what is overheating. If one is used to cooking one must have realized that when oil or fat is heated for the purpose of frying, it reaches a temperature point, at which it gives out blue visible fumes or smoke. The temperature at which any oil or fat begins to give out blue visible fumes, is called the smoke point or smoking temperature of that fat or oil. Different fats and oils have different smoke-points. If the oil or fat is heated above its smoke point, it is said to be overheated in which case it gives out lot of smoke. This is the faulty way of heating fats and oils, which invites rancidity too soon. Let us understand how rancidity develops on overheating. When any fat or oil is over-heated, it first hydrolyses or breaks into its original components, fatty acids and glycerol. During over-heating, this glycerol, further gets dehydrated to form a poisonous substance called acrolein, due to which rancidity is hastened. Rancidity

developed in this way due to hydrolysis of fats on over heating is called hydrolytic rancidity. Acrolein formed on hydrolysis of fat or oil is found in the smoke produced due to overheating. Acrolein has a very sharp odour and is irritating to the mucous membrane of nose, throat and eyes. It is because of this fact that if we stand near the smoking fat or oil, we should cough or our eyes would water because acrolein enters the eyes and also the nose and throat along with the air inhaled.

In short, overheating and repeatedly heating of fats and oils is not good, because hydrolytic rancidity develops in both the cases, making the fats and oils unfit for cooking. An important point to note here is, that we should not either overheat or underheat, the fat or oil for frying purpose because the disadvantage is that the food to be fried will burn from outside and will remain raw from within if fried in overheated oils or fats. Even underheating of fats or oils fails to fry the food properly because if the food to be fried is left in the oil or fat which is not heated enough, the food will take up more oil and thus become soggy or oily which will not at all be tasty then.

(vii) Deep frying and shallow frying method:

There are two methods of frying, shallow frying and deep frying. You already know that different fats and oils have different smoke-points. Generally oils have higher smoking temperatures compared to fats. For example, groundnut oil, til oil etc. would give out smoke at higher temperatures compared to fats like dalda, butter etc., which smoke at relatively low temperatures. The fats like dalda, butter etc. cannot be heated to high temperatures because they would burn away, as their smoke points are low. It is because of this reason only that snacks like Kachories,

bhajiyas, vadas etc. which need longer frying at high temperatures, have to be fried in oils and not in butter or ghee. On the other hand, we can use butter or any such fat to fry items like puda or egg-omlette which need very short frying time at low temperature. When foods are fried for a long time at high temperatures, a lot of oil, is taken in a deep frying pan. This method of frying is called deep frying method. But when foods are fried in a shallow-pan, for a short time, at low temperatures, using a little oil or fat, is called the "shallow frying" method. It is very clear that in shallow frying very little fat is used, which is generally all taken up by the food, and so no oil is left behind. Contrary to this for deep frying we use lot of oil, only part of which is absorbed by the food and much is left behind. This left over oil should not be repeatedly heated to be used for deep frying; instead it can be used for vaghars, for shallow frying or can be added to chapati atta. Very often the burnt particles of food are found in the left over oil; which should be strained out before it is stored for the further use. If burnt particles are not removed, you will mark that such an oil would start smoking at lower temperatures when subjected to heating again for frying. Not only presence of unwanted burnt food particles but also repeatedly heating of oils and fats lead to lowering of smoke points. Thus one should avoid the faulty ways of using the fats and oils.

(viii) Nutritive value of fats and oils:

Fats and oils are completely made of only one nutrient and that is fat. To be specific 100 grams of any fat or oil will give 100 grams of the nutrient called 'fat'. This means that fats and oils have cent percent fat and no other nutrient. Protein, carbohydrate, vitamin and mineral content of any oil or fat is nil. Only the hydrogenated vegetable fats like dalda, rasada, pakao, vanaspati etc. are enriched

with Vitamin A and Vitamin D.

(On the following day students were taken to the laboratory for demonstration which was followed by the lecture on the next day.)

(ix) Sources of fats:

According to the fat content, different foods are categorized as follows:

Very rich sources of fat: Since fats and oils contain 100 per cent fat, they are considered to be the very rich or the concentrated sources of fat.

Rich sources of fat: A good quantity of fat is present in foods like nuts such as cashewnuts, almonds, coconuts grounds etc. Besides these food, meat eggs, milk-cream, cheese, mava etc. too contain high amounts of fat. Therefore all these foods are termed as rich sources of fats.

Fair sources of fat: Cereals, pulses, fruits and vegetables are the fair sources of fat, as their fat content is very low.

Poor sources of fat: Foods which contain absolutely no fat are the sugar, jaggery and honey. Therefore these are referred to as the poor sources of fat.

(x) Ill effects caused by the excessive consumption of fats and oils:

If our daily meals contain excess of fats and oils and the other rich sources of fat, we would put on a lot of weight because some of the excess of fat consumed gets deposited in our body due to which we would become obese or very fat. So, one of the ill-effects caused is obesity.

The other ill-effect caused due to eating of large amounts of fats like ghee, butter and other fat-rich foods

etc., is the heart-disease. Generally the rich people who can afford to eat costly fats and fat-rich foods, are the victims of heart-disease. Heart-disease can be avoided by cooking and consuming our daily meals in unsaturated vegetable oils, in place of saturated fats. It is because of this reason that Punjabi people who cook their foods in ghees are the patients of heart-disease.

(xi) Recommended allowance of fat:

One needs, not in excess, but some amount of fat, daily, either in the form of pure fat or as it occurs in natural foods. The daily requirement or the recommended allowance of fat is 25 grams to 50 grams per an adult per day.

(xii) Digestion and absorption of fats:

Whatever fat we eat, first gets digested in pancreas by the action of an enzyme called steapsin which breaks down the fat into fatty acids and glycerol. These fatty acids and glycerol recombine or join together to form what is called neutral fat. To be exact each set of three fatty acids joined to a molecule of glycerol is termed the neutral fat.

These neutral fat is absorbed by the blood from the small intestine.

(xiii) Functions of fats:

The four main functions of fats are : (i) To give energy, (ii) to serve as the carrier of fat soluble vitamins, (iii) to keep the skin healthy, and (iv) to increase the satiety value of meals.

Each function is described below:

(i) To give energy:-

The main function of fat is to give energy. One gram of fat when oxidized in the body gives 9 calories, which is nothing but energy. Like proteins and carbohydrates which oxidize to give energy to our body, and so, are called the fuels for the body; so are fats called the fuels for the body, as they too oxidize in the body to release energy. In short proteins, carbohydrates and fats are the fuels for the body. But out of these three nutrients, fats give the maximum energy. As made clear in the previous two lessons, one gram of each, either protein or carbohydrates give four calories on oxidation, whereas one gram of fat gives nine calories.

(ii) To serve as carriers of fat soluble vitamins:-

Besides giving energy, fats also serve as carriers of fat soluble vitamins A, D, E, K. This means that vitamins A, D, E, and K will not be utilized by our body when our diets lack in fats and if vitamin A, D, E, and K are not utilized by our body, many important functions would not be carried out in our body. In short the function of vitamin A is to keep the eyes healthy, that of vitamin D is to help the growth of bones and to keep them strong, that of vitamin E is to help the process of reproduction and lastly the function of vitamin K is to help the co-agulation of blood; whenever it oozes out of the body. Thus our body would suffer a lot if fat is not taken in our daily diets.

(iii) To keep the skin healthy:-

Besides giving energy and serving as the carrier of fat soluble vitamins A, D, E, and K, fat is also needed to keep the skin healthy.

(iv) To increase the satiety value of our meals:-

Besides performing the three above mentioned functions,

fats also increase the satiety value of the meal which means fat present in our meals prevents the early return of hunger; because it remains in the stomach for a long time. In other words we would not feel hungry for a long time if enough fat is present in our meals.

Therefore it is important to include enough fat in daily meals as it would harm our bodies if our diets totally lack in fats. This fact needs emphasis, as the present trend amongst the adolescent girls, is to completely avoid fatty foods in order to remain very slim and thin. But this is not advisable. On the other hand, if one takes excess of fat as told before, one would be a round person and would sometimes suffer from the heart-trouble. So it is necessary to include the just enough quantity of fat in daily meals.

(Appendix D₁)

Unit I

PROTEINS

(Taped Commentary)

(For charts refer appendix E₁)

So far you have studied about all the seven food groups, namely, (1) cereals, (2) pulses, nuts and oil seeds, (3) fruits and vegetables, (4) milk and milk-products, (5) fats and oils, (6) sugar-jaggery, and (7) flesh foods. You know that these foods are made of nutrients such as proteins, carbohydrates, fats, vitamins and minerals. When we eat foods we get nutrients. We need nutrients, for many reasons, one of which is, to obtain energy to work. Plants can make three kinds of energy bearing substances known as proteins, carbohydrates and fats which man can use for his activities to survive. Proteins, carbohydrates and fats are also referred to as fuels, supplying energy, to our body. Just as train-engines, motor-cars and steamers receive energy from the fuels like coal, diesel, petrol etc. the human body gets energy from the fuels like proteins, carbohydrates and fats. Today we will study about the fuel, proteins.

So let us first understand the origin and meaning of the term protein. The word protein has been originated from the Greek word Proteos, PROTEOS, which means "to be first". Since proteos means to be first, proteins also mean "to be first". You will wonder, as to where proteins have to be first? Proteins being a kind of nutrient have to be naturally, first supplied in our daily meals. But why? This is because of the reason that the chief matter of all our body organs, like brain, heart, lungs, stomach, liver, small intestine, large intestine and kidneys, nerves, blood cells, walls of the blood vessels and the digestive tract is proteins. Even

hair, nails, skin and muscles consist almost entirely of proteins. These are the major components of bones and teeth too. In fact every living body cell and most of all the body fluids are made of proteins. In short our entire body is chiefly made of proteins; or we can also say that since the formation of living body is impossible without proteins, the meaning of the word protein, "to be first" is rightly justified.

Now we shift to study the chemical composition of proteins. Proteins are formed of compounds called Amino Acids. Just as bricks are required to construct a building, amino acids are required to build or form a protein. Therefore an amino acid, is a basic unit needed to form proteins. Remember, a single amino acid is never a protein, but many amino acids are required for building a protein. Each, such amino acid that goes to form a protein, is made of carbon, hydrogen, oxygen and nitrogen. Proteins are also called nitrogenous substances as they contain nitrogen. Now turn your eyes to chart no.1, on which is mentioned, the formula of an amino acid. If you observe the chart minutely, you will realize the presence of capital letters like C, H, O, N and R. Don't you? The letter C stands for carbon, H for hydrogen, O for oxygen, and N for nitrogen. R stands for the rest of the structure of an amino acid, which is different for different amino acids. Any way, what is important, is that, proteins are formed of carbon, hydrogen, oxygen and nitrogen. Please look at the same chart again, to study the formula of an amino acid in detail. The group on your left is NH_2 which is called amino group or basic group, the group on your right is COOH group which is called carboxyl group or acid group. On top is H which stands for hydrogen group and R, as you know, is for the rest of the structure present in an amino acid. It is the presence of NH_2 or amino group and COOH or acid group, that the compound is termed as an amino acid. Now would you like to test

your memory? Then come on, answer a few questions in your work sheet.

- Q.1 What is the meaning of the term protein? and why it is important to have proteins in our daily meals?
- Q.2 Why proteins are called nitrogenous substances?
- Q.3 What is an amino acid? Why it is called so? Write down its formula.
-

You have noted earlier that many amino acids are required to build a protein. Actually many amino acids join with one another to form a protein. It is very important to understand how each two amino acids join or link up in a protein molecule. Please focus your attention on Chart no.2 which explains the same. Here are just three amino acids joined together. Hundreds and hundreds of amino acids join in the same fashion, to form a protein molecule. If you look at the chart no.2 properly, you will realize that COOH group, of amino acid no.1, is joined to NH₂ group of the amino acid no.2 and again COOH group of amino acid no.2 is joined to NH₂ group of amino acid no.3 and similarly COOH group of no.3 would further join to NH₂ group of the amino acid no.4, and it will continue in the same way with the succeeding amino acids. What we conclude here is that, only unlike groups of each two amino acids join and never the similar groups join. A question arises then; what joins the each two amino acids? Just as two bricks are bound together by cement, in a wall, two amino acids, in a protein molecule are bound by what is called a peptide linkage. Turn your eyes to chart no.2 and take down the word "peptide linkage". Will you look at the next chart no.3? When a peptide linkage binds two amino acids the compound formed is called a di-peptide, please keep looking at the same chart, thoroughly, when three amino acids join the resulting compound is called a tri-peptide.

Similarly compounds formed of four, five, six and seven amino acids are called tetra peptide, penta peptide, hexa peptide and hepta peptide. But when more than seven amino acids join, the compound formed is called a polypeptide, as you can read on this chart, because, di means two, tri means three, tetra four, penta five, hexa six, hepta seven and poly means many. So the name given to the compound is according to the number of amino acids, it is made of. Isn't it? You have gathered enough information about amino acids but yet an important point you need to understand is the kinds of amino acids. There are two kinds of amino acids, namely the essential amino acids and non essential amino acids. Essential amino acids are ten in number. You can read their names on chart no.4. They are (1) Leucine (2) Lysine (3) Tryptophane (4) Threonine (5) Valine (6) Isoleucine (7) Methionine (8) Phenylalanine (9) Arginine and (10) Histidine. Please check, you have taken down these names with the correct spellings and once again also listen to their names for the correct pronunciation. (1) Leucine (2) Lysine (3) Tryptophane (4) Threonine (5) Valine (6) Isoleucine (7) Methionine (8) Phenylalanine (9) Arginine and (10) Histidine. Non essential amino acids are many but let us learn at least five names of the same. As you see them on the same chart no.4, their names are (1) Glutamic acid (2) Aspartic acid (3) Alanine (4) Proline (5) Hydroxy proline. Once again please listen to the names of non essential amino acids. (1) Glutamic acid (2) Aspartic acid (3) Alanine (4) Proline (5) Hydroxy proline.

Now let us study why some amino acids are referred to as essential amino acids and the other, as non essential amino acids.

Essential amino acids are called so, because, they have to be present in our daily meals, since they are not formed or made in our body; whereas, non essential amino

acids, are called so because, their presence in our daily diets, is not so essential, not so necessary, as they are formed in our body. However essential and non essential both kinds of amino acids are essential for our body, to be healthy. Essential amino acids are found in foods of animal origin like fish, meat, eggs, poultry, milk etc. Vegetarian foods like cereals, pulses, fruits and vegetables are not the good sources of essential amino acids. An important point to note here is that the proteins found in animal foods are the complete proteins as these proteins are composed of all the essential amino acids in the right quantity as needed by a normal healthy body; whereas the proteins present in plant foods are called the incomplete proteins which do not contain, all the essential amino acids, instead they lack in one or many amino acids.

Let us now revise a few points by answering the questions in your work sheet.

- Q.1 Which linkage joins each two amino acids in a protein molecule? Write, to show the five linked up formulae of amino acids.
- Q.2 Say, the number of amino acids present in the following compounds.
(i) Tetra peptide, (ii) Hexa peptide, and (iii) Hepta peptide.
- Q.3 From the following list of amino acids, sort out the essential and non essential amino acids.
(i) Tryptophane, (ii) Lysine, (iii) Alanine, (iv) Methionine, (v) Aspartic acid.
- Q.4 Which are the two kinds of proteins? Why they are called so? List atleast two foods which contain each kind of protein.
-

(On the following day, students were taken to laboratory, for demonstration. This was followed by the taped commentary on the next day.)

It is clear to you, that complete proteins found in animal foods are called so, because they contain all the essential amino acids in the right quantity, as needed by a normal healthy body. Complete proteins, are also called the first class proteins or the proteins of high biological value, as they are digested easily and utilized best and thus can support maximum growth and maintain optimum health. You also know that incomplete proteins are found in vegetarian foods and an incomplete protein is called so, because it is deficient in one or many essential amino acids. Besides, it cannot be digested and utilized so well as the complete protein, by our body, and thus, it alone cannot support maximum growth and cannot maintain optimum health. Therefore incomplete proteins are referred to as the proteins of low biological value. From the above information we can conclude, that the quality of protein in non vegetarian foods is better than that found in vegetarian foods; or all must eat non vegetarian foods, containing complete proteins only. But all people are not non-vegetarians. Moreover, foods like eggs, fish, meat etc. are very costly, compared to plant foods like cereals, pulses, vegetables etc. Therefore all people will not be able to afford non-vegetarian foods daily. And this, does not, also mean that vegetarian people, are not healthy or people who cannot afford animal foods, are unhealthy. The fact that some vegetarians get along quite well or are quite healthy, suggests, that all the essential amino acids can be made available to mankind, from plant foods alone! But how is this possible? So far, what you have observed is this, that plant foods contain incomplete proteins of low biological value. The how do we obtain complete proteins from plant foods or from vegetarian

foods? We can get complete proteins from plant foods also, if two or more plant foods, are combined judiciously as these can make up one another's, amino acids, deficiencies. For example, cereals lack in an essential amino acid lysine, but have methionine. Pulses are deficient in methionine, but are rich in lysine. Therefore if we combine a cereal and a pulse to make a preparation, it would have all the essential amino acids, or the nutritive value of a plant protein mixture would be always better, than that of any one plant food alone. For example Khichdi would be always better in its protein quality, than rice or dal alone. In simple words, we can say that if the protein of the diet is deficient in one or more of the essential amino acids, and if another protein containing the missing amino acid, is added to the diet, the protein quality can be improved. This capacity of the proteins to make good one another's deficiencies, is known as the supplementary value of proteins. In short incomplete plant proteins need to be supplemented; to improve the quality of protein. On the other hand animal foods containing complete proteins, made of all the essential amino acids, need not be supplemented. Any animal food can be eaten alone at a time. Thus animal foods such as eggs, meat, liver, poultry, fish, milk etc. are the rich sources of proteins, complete proteins. Do you see their pictures on chart no.5? Study the same chart, carefully and you will find that, the plant foods like cereals, pulses, nuts and oil seeds, fruits and vegetables, containing incomplete proteins which need supplementation to improve their quality of proteins, are the fair sources of protein. It is very important to note in this connection, that out of all the plant foods, just mentioned, quantity of protein in most of the pulses, nuts and oil seeds is same or even, in some cases, more than that present in the rich sources of proteins, i.e. the non vegetarian foods

which are labelled as rich sources of protein in the chart no.5. In spite of the fact that pulses, nuts and oil seeds contain more quantity of protein, compared to animal foods, are not considered as the rich sources of protein, because as you studied earlier, these contain incomplete proteins, and hence are considered inferior, protein-qualitywise. Apart from the foods containing more or less quantity and quality of proteins, there are foods, which contain absolutely no protein. They are, as you observe them on chart no.5, sugar, jaggery, cooking oils and fats.

Let us halt here, to answer a few questions in the work sheet.

- Q.1 Explain in few lines, What you understand by the proteins of high and low biological value?
- Q.2 Define supplementary value of protein and explain in detail why plant proteins need to be supplemented?
- Q.3 Which of the following groups of foods are rich, fair and poor sources of protein?

Group (a)	Group (b)	Group (c)
Sugar	Mango	Egg
Jaggery	Bengal gram	Meat
Til oil	Wheat	Fish
Ghee	Brinjal	Milk
Butter	Cashewnuts	Liver
	Groundnuts	

You have noted that except a few, many other foods contain more or less quantity of proteins. The proteins found in different foods are not alike. Protein in milk differs from protein in wheat, because the number and kinds of amino acids used, to form these proteins are not the

same. The proteins in the body, also vary widely for the same reason and therefore protein, of liver is unlike that of the muscles. Thus the proteins belonging to different sources have different names. Now concentrate on chart no.6 to learn a few names of proteins found in the different foods. Wheat protein is called Gluten, maize protein is called Zein. Casein is the milk protein. Myosin is the name of the protein found in meat. Egg protein is called albumin and lastly pulse-protein is called legumin. We have been talking about varieties of proteins so far. We also know which are the good quality proteins and have also learnt how to improve the quality of proteins. Next, what is important is, how much of proteins we should eat daily? The recommended allowance, or the daily requirement of proteins is different for different individuals, because individuals vary in age and sex. If you refer to the page no.27 of the book "nutritive value of Indian foods, which you use for your food practical classes, you will realise that a normal healthy man requires 55 gms. of protein daily, whereas a woman of the same age, doing same kind of work needs only 45 gms. of protein. This is because of the difference in sex. And if you see to the daily need of protein for just 7 years old child, it is 33 gms. which is much more for his age. This is because of the reason, that a child has to grow. He has to build his body which needs extra protein. This reflects that younger the individual higher is the protein need. We need to include proteins in our daily meals, since proteins perform many important functions in the body. Number one, protein helps the growth. Amino acids of proteins are used as building blocks, to construct the new body tissues, through out the entire growth period, from the very beginning of life, to complete the adult development. Therefore a child should be given enough of good quality proteins. Protein is very

essential for growth, but this does not mean that protein is not required after the growth is completed. The second function of protein is to maintain and repair the worn out body tissues. Just as the old house requires maintenance, to look sound, so we adults also require to maintain our body tissues, to remain healthy. Besides helping the growth in case of children and maintaining the body tissues in case of adults, the third function of proteins is to make in our body, many other compounds of tremendous importance to our health. These compounds are (i) Haemoglobin (ii) Enzymes (iii) Hormones and (v) Anti-bodies. Haemoglobin which is present in red blood corpuscles, and which has the capacity to carry oxygen, is made of two nutrients, haem and globin. Haem is iron and globin is a protein. Therefore we say that formation of haemoglobin requires protein. Besides, haemoglobin, proteins are also needed to form enzymes which help in many metabolic reactions in the body, and also hormones which regulate many body functions. Anti-bodies are the fourth important compounds formed by the proteins. These are found in blood and they protect the body by combining with bacteria or poison, which reaches the blood to destroy the same. The fourth function of protein is to give energy to our body. Our body uses proteins as a fuel which burn or oxidize in the body to produce heat or energy. This heat or energy is nothing, but what we commonly call as calories. Let us understand, a calorie, is equivalent to how much of heat. A calorie can be defined as the amount of heat, required to raise the temperature of one kilogram of water, through one degree centigrade. To follow this definition, still in a better way, understand the experiment which is as follows. Take one kilogram of water in a container. Note its original temperature using a thermometer. Suppose the original temperature is 15°C . Heat the same water, till the temperature reaches 16°C . "Whatever heat has been used for

raising the temperature of 1 kg. of water, from 15°C to 16°C, is equal to one calorie. We have noted that proteins also give energy. To be exact, when, one gram of protein, oxidizes or burns in the body it gives 4 calories. To summarize, proteins perform 4 important functions in our body. Number one - protein promotes growth; number two, protein helps to maintain the body tissues; number three, proteins form haemoglobin, hormones, enzymes and anti bodies; and number four, proteins give energy to calories or heat to the body.

Let us recall a few more points which we just studied, by writing out answers to the following questions.

- Q.1 Mention the names of proteins for the foods...
 (i) Milk (ii) Egg (iii) wheat (iv) Maize (v) pulse
 and (vi) Meat.
- Q.2 State the recommended allowance of protein for man, woman and a seven years old child. Explain why the daily requirement is different for different individuals?
- Q.3 State in brief the four important functions of proteins.
-

Learning these important functions of proteins you must have realized that proteins are needed by all, growing children, adults and old people too. If such a valuable nutrient, protein, lacks in daily diets, then all would suffer from the effects of protein deficiency. Isn't it right? Let us first concentrate on how growing children suffer, if their daily diets are deficient in proteins. You already know, that proteins are very necessary for growth, and so growing children should be given enough quantity and good quality of protein rich foods in their daily meals right from the age of three months. Certainly you are surprised at this statement, because generally it is wrongly

believed that three months, is too small an age, when a child can hardly take any other food, accept milk. Children can eat and digest, if protein rich foods are given in the semi-solid form. For example, soups of meat, vegetables and pulses; a mashed mixture of fruits and curds, any nut powder paste, half boiled eggs, puddings etc. can be fed to a child right from the age of three months i.e. when the weaning period starts. Weaning period is that period during which a child is given soft semi-solid preparations along with milk. If the daily diets of growing children lack the enough quantity and good quality of proteins containing foods, he suffers from a protein deficiency disease called Kwashiorkor, KWASHIORKOR. So, in other words, the cause of the disease is deficiency of protein during the weaning period. But why child is not given such necessary protein-bearing foods? One of the reasons is poverty, or lack of money to afford protein rich foods and the second reason is ignorance about nutrition. Many rich people, although can afford to give protein rich foods, to their children, lack the knowledge of nutrition, and ultimately their children also become the victims of Kwashiorkor.

Now wait a while to test your memory - come on, answer the following questions in your work sheet.

- Q.1 What is the right age when a child should be given semi-solid foods along with milk? What do you call this period?
- Q.2 What is the name of the protein deficiency disease? What is the cause of the disease?
- Q.3 Which are the two factors responsible for causing this disease?

Now we will learn a few clinical features or the external signs, of the disease, looking at which you can say

that the child suffers from the disease Kwashiorkor. Concentrate on chart no.7 to learn the same. The first external sign is that the child fails to grow since, protein which encourages growth, is absent in his meals. The second external sign is Oedema. OEDEMA, Oedema. This is the condition in which water collects in the body tissues in the place of protein due to which child looks plump and welled, although actually he fails to grow. Besides this the hair texture and colour are affected. Hair becomes lusterless, sparse, soft, and straight. The black colour of the hair turns either grey, brown, or light yellow. This is again because of the reason that hair made of protein, requires proteins to be healthy. The fourth external sign, or the clinical feature is mental apathy; MENTAL APATHY. The child becomes highly irritating. Any attempt to arouse his interest results in making him cry. The fifth clinical feature of the disease is vomiting and diarrhoea, which is because of poor digestion, which in turn is because of the decreased quantity of digestive enzymes which are formed of proteins. The undigested food is thrown out of the body in the form of either stools or vomits.

Now most important is the treatment of the disease. Since you know the cause of the disease and also the foods rich in protein, definitely you can think of certain food preparations which can help to cure the disease.

Here are a few food preparations which can be used to treat the disease Kwashiorkor. They are (1) Banana milk shake (2) Cashewnut or groundnut powder in milk (3) tomato meat soup (4) pulse and leafy vegetable soup (5) half boiled eggs (6) Canjee prepared out of wheat and bengal gram powder mixed with jaggery and milk (7) curds with mashed fruits etc.

Certainly you can, now, judge the disease from the clinical features and can also prescribe the treatment with foods.

Please understand the following situation and write answers in your work sheet:

Suppose your neighbour's eight months old child having straight sparse and grey coloured hair, looks very plump, although too light in weight and is least interested in surroundings. It often vomits and also passes stools number of times.

From your knowledge about these external signs, can you say that the child is suffering from any disease?

If yest, which disease?

What nutrient is deficient?

List any two protein rich semi-solid food preparations which can help to cure the disease.

So far you only studied how children are affected by the protein deficiency. You very well know that protein is not only required by the children, but also required by the grown ups, to maintain the body tissues; and so they also become victims of the effects of protein deficiency; if proteins constantly lack in their diets, muscles of such people lack tone and become soft and flabby; their nails break easily, and hair too loose luster and become sparse. Quantity of haemoglobin also reduces in R.B.C.s due to which enough oxygen is not supplied to the tissues, as a result, lack of energy follows. Lastly infection sets in, because anti-bodies are not produced in sufficient quantities, thus the liability to destroy, bacteria is greatly decreased.

So right from infancy, we all need protein to exist on this earth and that we would all lose health and suffer from many physical ill-effects if we become the victims of

protein deficiency. So the lesson on protein can be concluded as, 'if you wish to grow well and also desire to be attractive and healthy and remain so, throughout the years to come, see that your diet includes enough protein of high biological value, right from the infancy till you remain on this planet'.

(Appendix D₂)

Unit II

CARBOHYDRATES

(Taped Commentary)

(For charts refer appendix E₁)

We finished studying about the important energy giving fuel, used by our body, namely proteins. Besides proteins, 'carbohydrates' are also used as a fuel, to gain energy by our body. First let us understand what carbohydrates are made of, or what is the chemical composition of carbohydrates. You already know that proteins are made of carbon, hydrogen, oxygen and nitrogen. Carbohydrates are made of only the first three i.e. carbon, hydrogen and oxygen.

The term carbohydrates is the combination of the two words, carbo and hydrates. The word 'carbo' stands for the 'carbon' present in carbohydrates, and the word 'hydrate' indicates that generally hydrogen atoms and oxygen atoms are present in the proportion of two hydrogen atoms to one oxygen atom - so as to form water i.e. H_2O or the ratio of hydrogen atoms to oxygen atoms is generally 2:1, forming water and therefore we have the term 'hydrate'. This is how the full word carbohydrate is formed.

Arn't you anxious to know, now, as to where originally the carbohydrates are prepared and how exactly these are prepared? Look at the chart no.1, presented before you. It is the plants which make or manufacture the carbohydrates. Plants are the nature's carbohydrate manufacturers. Exactly, the green colouring matter, called the chlorophyll, present in the green leaves, utilizes water of the soil and carbon-dioxide of the atmosphere and makes or synthesizes carbo-

hydrates in the presence of sunlight. We can thus say that totally 4 things are needed by the plants to prepare carbohydrates. They are (i) chlorophyll, (ii) water, (iii) CO_2 , and (iv) sunlight.

Get ready for responding to a few questions now in your work sheet.

- Q.1 What are carbohydrates composed of?
 - Q.2 Explain the term carbohydrates.
 - Q.3 What prepares the carbohydrates and how?
-

The process by which plants prepare carbohydrates, utilizing 4 natural elements, as explained before, is called photosynthesis. Please turn your eyes to the same chart. Now understand what is exactly meant by the term photosynthesis. Photo means light and synthesis means to make. Therefore the term photosynthesis fully means to make something in the presence of light. In this case it is sunlight. This also explains that process of photosynthesis is impossible in the absence of sunlight or in other words, photosynthesis never occurs at night. Please write down the correct spelling of photosynthesis in your work sheet. PHOTOSYNTHESIS. Can you quickly draw the same chart in your work sheet?

This process of photosynthesis is very important for continuance of life on this earth, because the carbohydrates, prepared by this process are stored in the plants and are utilized by the human beings and plant eating animals, as the chief source of energy.

This leads us to a very fact, that the main function of carbohydrates is to give energy. It is very clear to you that, like proteins, carbohydrates are also a fuel which burns or oxidizes in the body, to produce heat which is

nothing, but calories or energy. It is very important to know that one gram of carbohydrate gives 4 calories, or in other words, 4 calories are obtained when one gram of carbohydrate is burnt in the body.

Let us try to recollect some of the major points, by answering a few questions.

- Q.1 Which is the process, by which plants prepare carbohydrates?
- Q.2 What is the main function of carbohydrates?
- Q.3 How many calories are produced when one gm. of CHO burns in the body?
-

You have followed that carbohydrates burn in the body or oxidize in the body to give energy but, how much of carbohydrates, we should include in our daily meals to get the sufficient energy? The recommended allowance of carbohydrates is roughly 350 gms. i.e. an adult person must consume approximately 350 gms. of carbohydrates per day, to achieve the necessary energy. You know that one gram of carbohydrate, on oxidation in the body, gives 4 calories, therefore, this 350 gms. of CHO will produce $350 \times 4 = 1400$ calories. Isn't it so?

You know the quantity of carbohydrates one must eat daily but don't you wonder exactly which foods are to be eaten to get the sufficient energy - or which foods impart more energy? Now turn your eyes to the chart no.2 which talks about the sources of CHO. As such carbohydrates are found in almost all the foods, in more or less quantity, except cooking oils and cooking fats such as groundnut oil, til oil, dalda, pure ghee, butter and so many, such other edible fats and oils, which completely do not contain any carbohydrates. Therefore these are considered to be poor

sources of carbohydrates. Do you see that on the chart? On the other hand, the concentrated or the richest sources of carbohydrates are sugar, jaggery and honey. These are called the richest sources of CHO's because sugar contains 99.4% of CHO, jaggery contains 95% of CHO^s and honey contains 94% of CHO. But we do not use them as much as we use the other foods, as these are only used as the sweetening agents. Cereals like rice, wheat, bajra etc. which form the bulk of our daily gujarati diets, contain 65% to 70% of carbohydrates. Besides cereals and root veg. included in our daily meals, also give good quantity of carbohydrates. Therefore we can say, that we get maximum carbohydrates from the cereals and root vegetables, present in our every day meals. Pulses, nuts and oil seeds which also contain considerable amount of carbohydrates are the next important sources of carbohydrates. Leafy vegetables and other vegetables are very low in their carbohydrate content. Any way all the foods, except cooking fats and oils, contain carbohydrates as you see on the chart. In short, sugar, jaggery and honey are the richest, cereals and root vegetables are the rich and cooking fats and oils are the poor sources of CHO.

Let us halt here to revise what we learnt so far, by answering a few more questions in your work sheet.

- Q.1 Approximately how many grams of carbohydrates one must include in the daily diet and how many calories can be obtained from that quantity?
- Q.2 Here are the names of 4 foods, 1. Jowar, 2. Potato, 3. Jaggery, 4. Pure ghee. Say which is the very rich, rich and poor source of carbohydrate.
-

You have gathered that many foods contain carbohydrates, but the carbohydrates present in different foods are not of

the same kind. For example, sugar is very sweet where as, rice is not, although both contain a lot of carbohydrates. Different kinds of carbohydrates having significance in nutrition are broadly classified into 3 main groups, as shown in the chart no.3. They are Mono-Saccharides, Di-Saccharides and Poly-Saccharides. The three kinds of carbohydrates are the mono-saccharides, di-saccharides and poly-saccharides. Mono-saccharides are the simple sugars. Mono means one and saccharid means sugar; therefore mono-saccharide completely means one-sugar, but it precisely means a simple sugar. Mono saccharides are called simple sugars because they contain just one molecule of sugar. Next is the di-saccharides. Di means two, not one, but two and, you know what saccharide means, it means sugar. So di-saccharides fully means two sugars or more correctly double sugars. So, why at all do we call them di-saccharides? Di-saccharides are called, so, because they are made of two mono saccharides. In simple words when two mono saccharides join, a di-saccharide is formed. The last and the third kind of CHO^S is the poly-saccharides. Poly means many, not one, not two also, but many many; and as you know the meaning of saccharide, is sugar. Isn't it? So poly-saccharide means a multiple-sugar. Not simple, not double, but a multiple sugar. Poly saccharide means a multiple sugar because it is formed of many many molecules of mono-saccharides. We will further study about each kind of carbohydrate in detail.

First we will concentrate on mono-saccharide. The examples of mono-saccharides are mentioned on the chart no.4. Let us read them out. They are (i) Glucose (ii) Fructose (iii) Galactose. Once again glucose, fructose and galactose. Note the correct spelling of each of these. All these three mono-saccharides have two common properties i.e. they are all soluble in water and they are not at all affected by

the digestive enzymes, that means they do not undergo any digestion; they do not require any digestion.

The first mono-saccharide glucose, which is sweet in taste, is found in most of the fruits, vegetables and in immature cereals as indicated on the chart. Besides these food sources our blood, also contains glucose. Can you see the picture of the same on the chart? It is therefore that glucose is also referred to as blood sugar. But how much glucose is present in our blood? The normal blood level of glucose is 80 mgs. to 90 mgs. per every 100 ml. of blood, or every 100 ml. of our blood contains 80 to 90 mgs. of glucose. Sweet glucose powder available on market is given to sick people to get energy, because it is readily absorbed and utilized by our body.

Fructose:- Another mono-saccharide is fructose. It is a very sweet kind of CHO, sweeter than glucose also. It is about 2.5 times sweeter than glucose. It is mainly found in sweet ripe fruits, honey and vegetables as the chart indicates. Of-course, as you know it being a simple sugar or a mono saccharides does not undergo any digestion, but it is utilized by our body, only after being converted to glucose. Remember it is not used in its own form, but gets converted to glucose, before being utilized by the body.

The third mono-saccharide is galactose. It does not occur alone in the nature, but is found in milk, combined with glucose to form milk sugar. So the source of galactose is the animal food, namely milk as shown in the chart. We conclude here that glucose and fructose are the CHO of plant origin as these are found in the plant foods like fruits, vegetable etc. where as galactose is of animal origin as it is found in milk, which is an animal origin food. Hope this is very clear to you. Like fructose, galactose is also utilized by the body, only after being converted to glucose.

Turn your worksheets and attempt the questions on what we just studied.

- Q.1 Which are the three kinds of CHO?
- Q.2 Why honey is very sweet?
- Q.3 Which is the blood sugar and what is its blood level?
- Q.4 Name the mono-saccharide present in the following:
Ripe mango, immature wheat and milk.
- Q.5 Why glucose is given to sick people?
-

Now let us keep the mono-saccharides aside and shift to study the second kind of carbohydrates called the Di-saccharides. Will you please look at the chart? The chart no.5? The examples of di-saccharides are (i) sucrose (ii) maltose (iii) lactose. Once again the three di-saccharides as mentioned on the chart, are sucrose, maltose and lactose. Note their correct spellings in your work sheet.

The first di-saccharides sucrose is nothing but the sweet table sugar which you put in your tea or coffee, or milk every morning. It being a di-saccharide, it is formed of two mono-saccharides namely glucose and fructose, or glucose + fructose make sucrose. Can you see that on the chart? You know that sugar is made out of sugar cane and sugar beets therefore these are also the sources of sucrose. Besides sugar cane and sugar beet, sucrose is also found in sweet fruits. Therefore, it is called fruit sugar. What is the fruit sugar? It is sucrose. Like fructose it is sweeter than glucose, but only 1.5 times sweeter than glucose.

Which is the next example of di-saccharide you see on the chart? It is maltose. It is called so because it is found in malted cereals - not in simple cereals but in malted cereals and therefore only it is called maltose. Thus

maltose is a cereal sugar. It is a di-saccharide and therefore naturally, it is made of two mono saccharides. Read on the chart exactly which two mono saccharides together form maltose? It is glucose and glucose. What forms maltose? We can also say that two units of glucose form maltose.

The third example of a di-saccharide mentioned on the chart is lactose. It is also made of two mono-saccharides namely glucose and galactose. Which two mono saccharides form lactose? It is glucose and galactose together, that they form lactose. Which food contains lactose? Look on the chart - it is milk and milk products like curds, butter milk etc. Because lactose is found in milk, it is referred to as milk sugar.

According to the sources, that these di-saccharides are found in, as you see them on the chart, we can, once again in short say that sucrose is a fruit sugar, maltose is a cereal sugar and lactose is the milk sugar.

Now would you like to test your memory? Then come on solve a few questions in your work sheet. Be quick, please!

Q.1 Here below are the three pairs of mono saccharides. Guess correctly, which di-saccharides result from each of these.

- a) Glucose + glucose
- b) Glucose + galactose
- c) Glucose + fructose

Q.2 Suppose you had the following foods in your lunch yesterday. Name the di-saccharides present in them.
Malted wheat gruel.

Curds,

Sweet Banana.

We studied about the two main kinds of carbohydrates; mono-saccharides and di-saccharides. Please turn yourself to the chart no.6 to get acquainted with the third and the last kind of carbohydrate called poly-saccharide. Some of the examples of poly-saccharides having importance in nutrition are (i) starch (ii) glycogen and (iii) cellulose. The three polysaccharides about which we will collect some information are starch, glycogen and cellulose. These have two common properties, one is that, all these polysaccharides are not soluble in water and the other is that, these are not at all sweet.

If added to water, will these become one with the water? Of course not. right? Are they sweet in taste? No, they are not sweet in taste.

Now get your self ready to gather more facts about each poly-saccharide individually. Please fix your attention on the same chart. The first is starch. This is the most common polysaccharide used by himan beings, and the animals. It is formed of many, many molecules of glucose, or many glucose units together form starch. As shown by the chart, the chief foods which contain starch, are the cereals such as rice, wheat, maize etc. and the root vegetables, such as potatoes, sweet potatoes etc. In other words cereals and root vegetables are the rich sources of starch.

What is the name of next poly-saccharide, that you can read on the chart? It is glycogen. Like starch glycogen is also made of many many glucose units. Therefore we can say that starch and glycogen have the same chemical composition i.e. both are made of many glucose units. But they differ in the sources they belong to. Like starch, glycogen is not found in any food, but it is made in our body, from the extra glucose. Whenever our body has some more glucose, which it does not need, it is converted into glycogen which is then

stored in the liver and muscle tissues. Whenever the dietary supply of CHO is inadequate, the glycogen stored in the liver gets easily converted to glucose which can be used by the body as the immediate source of energy. Besides, the amount of glycogen stored in the liver is more than that stored in the muscle tissue. Therefore liver is the principal store house of glycogen, which is used as the source of energy by the body. In short we conclude that starch and glycogen differ in their sources, but are similar in their chemical composition. Therefore glycogen is also referred to as animal starch. Animal starch is nothing but glycogen.

The third and the last example of polysaccharide, as you observe on the chart is the cellulose. Cellulose is not utilized by our body as the source of energy as the starch and glycogen are utilized. It is only thrown out of the body, unused as a waste through faeces, because it is not digested in our body. The question arises then, why cellulose is not digested in our body? and if it is not digested in our body, why it should be included in our diets? The reason why cellulose is not digested in our body is that our digestive system lacks the enzyme called cellulase which helps in the digestion of cellulose. Which enzyme is not present in our digestive system? The enzyme cellulase, c e l l u l a s e, cellulase. What is its function? Cellulase helps in the digestion of cellulose. Because we do not have the enzyme cellulase, we cannot digest cellulose. Contrary to this plant eating animals like cows, sheep, goat etc. can digest cellulose as their digestive system has the enzyme cellulase. Do you know, in what foods you find cellulose? Cellulose is also found in plant foods, like starch, but the difference between starch and cellulose is that, starch is found in the edible portions of the plant foods whereas cellulose is found in the non edible portions of the plant foods like peels of

fruits and vegetables and in the skin or outer coatings of cereals. It is abundantly present in grass too. You can guess the reason here, as to why plant eating animals live on grass whereas we never eat grass; we can never digest it. Cellulose is also called as roughage. Although it is not digested, it offers a valuable service, by forming a bulk, which makes for intestinal hygiene. In other words, cellulose being a roughage, helps the bowel waste to be voided regularly thus preventing the tendency to constipation. Therefore though cellulose does not improve the nutritive value of our food - or though we do not use it as the source of energy, like we use the other carbohydrates, we must include cellulose containing foods in our daily diets, as they help in the elimination of the bowel waste. An important point to note here is that the two polysaccharides which do not undergo digestion are glycogen and cellulose and the one which has to undergo digestion before being utilized, is the starch. Am I right? Stop for a while and try these questions now!

- Q.1 Which polysaccharide, you can get from each of the following foods?
- a) Peels of brinjals and cucumber.
 - b) Outer coating of green gram.
 - c) Yam and sweet potato.
- Q.2 Which polysaccharide is not found in foods and where is it stored in the body?
- Q.3 Which polysaccharide is thrown out of the body without being digested? Why is it so? What is the disadvantage if it is absent in our meals?
- Q.4 Which polysaccharide undergoes digestion?
-

It is clear to you that amongst polysaccharides only starch is digested. Similarly, amongst disaccharides, if

you see, all of them, undergo digestion. Starch being multiple sugar and di-saccharide being compound sugar, necessarily have to be broken into their most simple units, before they are absorbed and utilized. On the other hand mono saccharides being the simple sugar, require no digestion. They are simple, single sugars and therefore they can be absorbed as such and then utilized. Let us keep aside all the mono-saccharides and the poly-saccharides cellulose and glycogen, which do not go under any digestion, and talk about only the di-saccharides sucrose, maltose and lactose, and a poly-saccharide namely starch which do undergo digestion before being absorbed and utilized. So we shift to learn how these are digested.

You know that each di-saccharide is made of two molecules of mono-saccharide. During digestion, these two molecules of mono-saccharide break - or separate, by the action of the enzymes. Observe the chart no.7 thoroughly and you will understand the digestion of the carbohydrates. Let us discuss about sucrose first. Sucrose is acted upon by sucrase, an enzyme which breaks it into glucose and fructose. If you recall, sucrose is originally made of these two mono-saccharides. right? Second is maltose which is acted upon by the enzyme maltase which breaks it into glucose and glucose. You know that maltose is made of two units of glucose. Do you agree? Lactose is acted upon by the enzyme lactase and gets splitted into glucose and galactose, which together form lactose. So sucrase acts on sucrose, maltase acts on maltose, and lactase acts on lactose. This digestion occurs in small intestine. Now is the turn of starch. What does the chart say? Starch is digested at two sites one in the mouth and second in the pancreas. When we chew the food, it mixes with the saliva which has an enzyme called ptylin. This ptylin acts on some of the cooked starch and breaks it into maltose - a pair of

two glucose units, correct? Once again only cooked starch is acted upon by ptylin which breaks it into maltose. Whatever cooked starch or uncooked starch that has escaped digestion in the mouth is digested in the pancreas by the enzyme Amylopsin, which also breaks it into maltose. The maltose obtained by the action of either ptylin in the mouth or by amylopsin in the pancreas, is broken in to glucose and glucose by maltase; in the small intestine. Thus we finally get many glucose units from the digestion of starch because it is originally made of many glucose molecules. The glucose thus formed is absorbed, and utilized as the source of energy.

So, this is how, sucrose, maltose, lactose and starch are digested, after digestion, absorption occurs and it is after absorption that the body can utilize these carbohydrates. All the carbohydrates which are utilized by the body, are all utilized only after they have been converted to glucose, or it is in the form of glucose that all the carbohydrates are utilized by the body. Suppose some of the glucose formed in the body from the carbohydrates present in our foods, is not utilized by the body, it will collect in the blood, or whatever is the unused glucose, will keep on gathering in the blood. The blood will have more and more glucose i.e. even much more than the normal level of glucose in the blood. Do you know, why this happens? The causes are two. Number one, if the hormone, insulin which helps the utilization of glucose is not secreted in enough quantity - because less insulin less glucose will be utilized and number two, if we consume too much of carbohydrates containing foods daily, then also more and more quantity of glucose will be formed which will collect in the blood. In other words if we daily eat root vegetables, cereals, and sweet dishes prepared out of sugar

and jaggery in excess, the glucose, will also be formed in excess and thus whatever extra glucose which will not be utilized by our body, will pile up, or will gather in the blood. But how much glucose blood can hold? There is limit for this. You know the normal blood glucose level. Isn't it? If the blood is analysed in the laboratory half an hour after the meal is taken, the quantity of glucose in the blood, is found to be more or we can say that level of glucose in the blood rises, i.e. the glucose concentration goes higher than 80 to 90 mgs. per every 100 ml. of blood, depending upon the carbohydrate content of your food.

Blood can hold glucose maximum upto 140 mgs. to 150 mgs. of glucose for each 100 ml. of blood. It generally cannot hold more than this. It is then thrown out of the body via urine. Presence of glucose in the urine is the sure sign of the disease diabetes, d i a b e t e s, i.e. on testing in the laboratory, if the urine is found to contain glucose, it indicates the presence of the disease diabetes. Please note the spelling of diabetes d i a b e t e s - diabetes. The other method of detecting the presence of diabetes is by analysing the blood for its glucose content. If the glucose level of blood remains approximately 140 to 150 mgs. of glucose per every 100 ml. of blood constant, for more than three hours, it is also a certain sign of diabetes. Diabetes is such a disease which cannot be cured completely but it can be controlled to an extent. As nutritionists we can control the disease by the use of right foods. You now know that, one of the reasons for the occurrence of diabetes is the consumption of too much of carbohydrate rich foods in our daily meals. Therefore to control diabetes partially, the patient must avoid sweet foods like cakes, puddings, custards, jellies, jams, chocolates, chikies, chewing gums, sweet drinks like coca cola, fanta, sherbats, cordials, sweet fruit juices etc.

Besides, cereals like rice, and root vegetables like potatoes and sweet potatoes etc. should be avoided. Fried foods are also to be avoided as it is very necessary to control the body weight, when one suffers from diabetes. To be on safe side, a diabetic patient must eat a low calorie diet including plenty of other veg. and leafy vegetables, sprouted pulses, fermented foods, boiled eggs and meat, milk, curds and citrous foods.

So we conclude the lesson on carbohydrate by remembering a very important point, that the richest and rich sources of carbohydrates are energy giving no doubt, but at the same time, if consumed in excess are health spoiling.

Now respond to the following questions in your work sheet.

- Q.1 Analysis of which two body fluids help you to know the presence or absence of diabetes and how?
- Q.2 Mention two chief causes of diabetes.
- Q.3 How can you control diabetes with foods?

(Appendix D₃)

Unit III

FATS

(Taped Commentary)

(For charts refer appendix E₃)

You have studied about the two important fuels or energy giving nutrients, namely the proteins and the carbohydrates. The third equally important, and the maximum energy giving fuel or nutrient is the fat. When we hear the word fats, we associate it with something oily or greasy. Out of the seven food groups, that you know which is the food group, you think is oily or greasy? Certainly you will say "fats and oils"! Is this correct? Let us then learn about fats in details today.

First we will just get familiar with the kinds of edible cooking fats and oils, available on the market. If you look at the chart no.1, you will be able to get many many names of these along with the sources, they are obtained from. They are : 1. Groundnut oil prepared from groundnuts, 2. til or gingelly seed oil made from gingelly seeds, 3. Coconut oil extracted from coconuts, 4. Soyabean oil from the pulse soyabean, 5. Corn oil from corns, 6. Mustard oil from mustard seeds, 7. Cotton seed oil obtained from cotton seeds and 8. Sun flower oil from the sun-flower. These oils are called vegetable oils, as they are all extracted from one or the other plant source. Please keep looking at the same chart to know about fats. The fats which we use for cooking are pure ghee and butter, which are both obtained from milk. Besides these two milk fats, people use the fat called lard - L a r d, which is obtained from pork meat, and also the fat called tallow - t a l l o w, extracted from beef or mutton as you can read

from the chart. As these four fats are obtained from milk or a kind of meat which are animal foods, these fats, are referred to as animal fats.

Many people also use vegetable ghees like dalda, rasada, pakao, lotus which are, of course not pure ghee. These different kinds of ghees are not obtained from any animal food source, like the other fats. These are made in the factory from vegetable oils, therefore these are called vegetable ghees.

Now would you like to test your memory? Then come on answer a few questions in your work sheet.

Q.1 Name the sources of the following oils and fats.

- (i) Gingelly seed oil (ii) Soyabean oil (iii) Tallow
- (iv) Dalda.

Q.2 Give reasons for the following.

- (i) Dalda, pakao etc. are called vegetable ghees.
- (ii) Edible oils like, coconut oil, groundnut oil etc. are called vegetable oils.
- (iii) Pure ghee, lard and tallow are referred to as animal fats.

Now we shift to learn about the chemical composition of both, the fats and oils which are commonly called as fats as they are entirely made up of fat, or in other words fats and oils contain only one nutrient called fat. This nutrient fat is basically made of the same elements namely carbon, hydrogen and oxygen, as the carbohydrates are made of. You will wonder then, what is the difference between carbohydrates and fats? Fats contain much less oxygen and much greater proportions of carbon and hydrogen as compared to carbohydrates. In short the proportion of carbon,

hydrogen and oxygen is not the same for fats and carbohydrates. Now turn your attention to chart no.2. Carbon, hydrogen and oxygen present in fats, together form fatty acids and glycerol. These compounds together serve as the basic unit in the formation of fats. Look at the same chart attentively. To be more correct in each molecule, of fat present in either animal fat or vegetable oil, three fatty acids are found attached to one molecule of glycerol. This reflects that all the fats and oils have the similar basic chemical composition.

Now revise a few points by answering a few questions in your work sheet.

- Q.1 How do fats differ from carbohydrates as far as their chemical composition is concerned?
- Q.2 State the number of fatty acids and glycerol molecule which together form the basic unit of fat.
- Q.3 Explain - the chemical composition of fats and oils is similar.

Now concentrate on chart no.3. Fats and oils having the same chemical composition, are also similar as far as their physical properties are concerned. They are both lighter than water and are also not soluble in water. To prove this put a tea-spoon of either butter or any cooking oil, in a pot containing water, you will find that butter is separately seen on the surface of water and you will also observe distinctly round big and small droplets of oil on the surface of water. You will now agree that any fat or oil, since, it is found on surface of water, is lighter than water, and since they are seen separately in the water, they do not have the tendency to mix with the water. That is they are not soluble in water. Isn't it? The fats and oils having the same physical properties also have the same culinary role, which means they are used mainly for the same

purposes in cooking the foods. Fats and oils are used either to bring out flavour or to produce good texture or sometimes to achieve both flavour and good texture in cooked foods. For example, oil or ghee is used for making vaghars. In this case the purpose is to increase the flavour. Oil or fat added to bread or chapati atta, chiefly helps to produce good texture in the final product, whereas oil used for making upma or ghee used for making sheera helps both, the texture as well as flavour of the cooked product.

Although fats and oils have the same chemical composition physical properties and the functions in the food preparations, these are called differently as fats and oils. Certainly you must be wondering as to why, these do not have one common name? Or what must be the difference between these two? Look at the chart no.4 which explains the same. The main difference between the oils and fats is that, oils are liquid whereas, fats are solid at room temperature, but why so? This is because of the reason that oils are unsaturated while the fats are saturated compounds. This reflects that in structure of oils all the four valencies of each carbon atom are not satisfied and thus there are double bonds existing between carbon atoms. In case of structure of fat all the four valencies of each carbon atom, are satisfied and hence there are no double bonds existing. This shows that fats are saturated compounds.

Let us recall a few more points which we just studied.

Q.1 Justify the following statement:

Fats and oils have the same physical properties and the culinary roles.

Q.2 What is the chief difference between fats and oils?
What is this difference due to?

It is very important to note here that unsaturated vegetable cooking oils can be converted to saturated cooking

fats. You have been already told that vegetable ghees like dalda, rasda, pakao, lotus etc. are prepared from vegetable oils. But how? Vegetable ghees are prepared from oils, in the factory, by adding hydrogen atoms to oils, which the oils can readily take up since they are unsaturated. The process by which hydrogen atoms are added to unsaturated oils to convert them, into saturated ghees, is called hydrogenation, and it is only because of this that the vegetable ghees manufactured by this process are called hydrogenated ghees or hydrogenated fats. But a question arises, what is the need of converting oils into such kind of ghees? or Why oils should be hydrogenated? One of the reasons is that, some of the dishes cannot be cooked or flavoured without ghee and you definitely know that pure ghee which is prepared from milk is very costly, about 22 rupees per Kg. All people cannot afford to buy pure ghee. Instead, the desired flavour of ghee can be achieved by using the hydrogenated fats like dalda etc. which are available at cheaper rates compared to pure ghee, that is about 10 rupees per Kg. The another advantage of hydrogenating oils is that, they can be stored for a longer time without becoming stale.

The oils and fats develop disagreeable flavour when they spoil or become stale. Such spoilt or stale oils and fats which are not fit for cooking are called rancid oils or rancid fats. We can also say that rancidity R A N C I D I T Y, rancidity develops in fats and oils.

Turn your work sheets and attempt the questions on what we just studied.

- Q.1 Name and explain the process by which vegetable oils are converted to saturated fats. Also state the advantage of it.
- Q.2 When can you say that fats and oils are rancid?

To be protected against rancidity, fats and oils if stored, to be used in future, they should be stored in tightly closed containers in a cool dry place, otherwise the microbes or the harmful organisms grow on them and turn them rancid. Now turn to chart no.5. Rancidity which develops due to growth of microbes on fats and oils, stored in open containers in moist places, is termed microbial rancidity. Another important point to be remembered about the care to be taken during the storage period as shown on the same chart, is that fats and oils should not be contaminated with metals like copper, iron etc. because if they come in contact with these metals, they get oxidized. Oxidation of fats and oils, also occur if the direct sunlight falls on them. In simple words iron or copper spoon should not be left permanently in the fats and oils, and also these should not be stored in open containers in the place where the sunlight can directly attack them; otherwise they would be oxidized and become rancid. The rancidity caused due to oxidation of fats and oils, is called oxidative rancidity. Both fats and oils become rancid, if these are repeatedly heated. A very familiar example to quote here is, most of you must have enjoyed eating hot bhajiyas, available in market shops. Haven't you? But have you ever looked at the oil in the big deep frying pan in which they constantly fry bhajiyas for days together? If you have seen that oil in the deep frying pan, you would agree that such an oil has off colour or dark greenish colour, because it has been repeatedly heated or heated number of times. Such an oil is a rancid one and is generally toxic or poisonous, not at all good for our health. Shopkeepers will never use a fresh lot of oil, each time they fry, because oils are very costly. We should avoid eating the products fried in such oils. Oils and fats also become rancid if they are over heated. Now let us understand what is over heating. If you are used to cooking you must have realized that when oil or

fat is heated for the purpose of frying, it reaches a temperature point, at which it gives out blue visible fumes or smoke. The temperature at which any oil or fat begins to give out blue visible fumes, is called the smoke point or smoking temperature of that fat or oil. Different fats and oils have different smoke-points. If the oil or fat is heated above its smoke point, it is said to be over heated, in which case it gives out lot of smoke. This is the faulty way of heating fats and oils, which invites rancidity too soon. Aren't you eager to know how, rancidity develops on over heating? When any fat or oil is over heated, it first hydrolyses or breaks into its original components, fatty acids and glycerol. During over heating, this glycerol, further gets dehydrated to form a poisonous substance called Acrolein, due to which rancidity is hastened. Rancidity developed in this way due to hydrolysis of fat on over heating is called hydrolytic rancidity. Acrolein formed on hydrolysis of fat or oil is found in smoke produced due to overheating. Acrolein has a very sharp odour and is irritating to the mucous membrane of nose, throat and eyes. It is because of this fact that if we stand near the smoking fat or oil, we would cough or our eyes would water, because acrolein enters the eyes; and also nose and throat along with the air inhaled.

In short, overheating and repeatedly heating of fats and oils is not good, because hydrolytic rancidity develops in both the cases, making the fats and oils unfit for cooking. An important point to note here is, that we should not, either overheat or underheat, the fat or oil for the frying purpose because the disadvantage is that the food to be fried will burn from outside and will remain raw from within if fried in overheated oils or fats. Even underheating of fats or oils fails to fry the food properly because if the food to be fried is left in the fat or oil, which is not heated enough, the food will take up more oil and thus become soggy

or oily which will not at all be tasty then. Stop for a while and try these questions now.

- Q.1 Which are the three kinds of rancidities? Discuss in brief how each kind of rancidity develops.
- Q.2 Explain the following terms,
a) Smoke point, b) Over heating, c) Repeatedly heating.
- Q.3 Why satisfactory frying is not helped if fats or oils are over heated or underheated?

You already know that different fats and oils have different smoke points. Generally oils have higher smoking temperatures compared to fats. For example, groundnut oil, till oil etc. would give out smoke at higher temperatures compared to fats like dalda, butter etc. which smoke at relatively low temperatures. The fats like dalda, butter etc. cannot be heated to high temperatures because they would burn away, as their smoke points are low. It is because of this reason only that snacks like kachories, bhajiyas, vadas, etc. which need longer frying at high temperatures, have to be fried in oils and not in butter or ghee. On the other hand we can use butter or any such fat to fry items like puda or egg-omlette which need very short frying time at low temperature.

Please look at the chart no.6 carefully to know the methods of frying and the difference between these.

When foods are fried for a long time at high temperatures a lot of oil is taken in a deep frying pan. This method of frying is called deep frying method. But when foods are fried in a shallow pan, for a short time, at low temperatures, using a little oil or fat, is called the "shallow frying" method. It is very clear that in shallow-frying very little fat is used, which is generally all taken up by the food; and so no oil is left behind. Contrary to this for deep frying we use lot of oil, only part of which is absorbed by the food

and much is left behind. This left over oil should not be repeatedly heated, to be used for deep frying, instead it can be used for vaghars, for shallow frying or can be added to chapati atta. Very often the burnt particles of food are found in the left over oil, which should be strained out before it is stored for the further use. If burnt particles are not removed, you will mark that such an oil would start smoking at lower temperatures when subjected to heating for frying. Not only the presence of unwanted burnt food particles but also repeatedly heating of oils and fats; lead to lowering of the smoke points. So you are now thorough with the healthy ways of using fats and oils.

Some people are very fond of eating varieties of fried foods or oily foods daily. This is not a healthy practice. You know the fact that any fat or oil is completely made of only one nutrient and that is fat, or in other words 100 grams of any oil or ghee would give 100 grams of fat and no other nutrient. This means that fats and oils have cent percent fat. We can also say that protein, carbohydrates, vitamin and mineral content of any oil or fat is nil. Only hydrogenated vegetable fats like dalda, vanaspati, pakao etc. are enriched with vit.A and vit.D. Now respond to the following questions in your work sheet.

- Q.1 State the four main differences between the two methods of frying.
- Q.2 Why oils are used for deep frying and fats are used for shallow frying?
- Q.3 What leads to lowering of the smoke point?
- a) Write down how much of fat, proteins, carbohydrates, vitamins and minerals you would get from 50 gms. of groundnut oil used to prepare your full day meal.

Since fats and oils contain 100 per cent fat, they are considered to be the very rich sources of fat. Can you mark that on chart no.7? Besides pure fats and oils, we also get good quantity of fat from the foods like nuts, such as almonds, cashewnut, dry coconut, groundnuts etc., and from meat, eggs, milk-cream, cheese and mava which are the rich sources of fat. These are the rich sources of fat and are not the very rich sources of fat, because these do not contain 100 per cent fat as the cooking fats and oils contain. Cereals pulses and fruits and vegetables are the fair sources of fat as their fat content is very low. The foods which contain absolutely no fat are the sugar, jaggery and honey. These are therefore referred to as the poor sources of fat.

If our daily meals contain lot of fats and oils, and the other rich sources of fat, we would put on lot of weight because some of the excess fat consumed, gets deposited in our body due to which we would become obese or very fat. So, one of the ill effects caused, when many fatrich foods are included in daily diets is Obesity, O b e s i t y.

The other ill effect caused due to eating of large amounts of fats like ghee, butter and fat-rich foods is, the heart disease. Generally rich people who can afford to eat costly fats and fat-rich foods are the victims of heart disease. Heart disease can be avoided by cooking and consuming our daily meals in unsaturated vegetable oils; in place of saturated fats. It is because of this reason that many punjabi people who cook their foods in ghees are the patients of heart disease. What we have been discussing so far is the two ill effects caused due to excessive use of fats and fat-rich foods. Of course not in excess, but some amount of fat, we daily require, either in the form of pure fat or as it occurs in natural foods. Daily, one requires about 25 gms. to 50 gms. fat. In better words the recommended allowance of fat is 25 gms. to 50 gms. per an adult per day. Whatever fat

we eat, first gets digested in pancrease by the action of an enzyme called steapsin, s t e a p s i n, which breaks down the fat into fatty acids and glycerol. These fatty acids and glycerol recombine or join together to form what is called the neutral fat. To be exact each set of three fatty acids joined to a molecule of glycerol is termed the neutral fat. The neutral fat is absorbed by the blood from the small intestine. The fats absorbed are ready to carry out many functions in the body. The main function of fat is to give energy. One gram of fat when oxidized in the body gives 9 calories, which is nothing but energy. You have learnt that proteins and carbohydrates, since they oxidize to give energy to our body, are considered to be fuels for the body; so is the case with the fats. Since fats also oxidize and release energy, they are also the fuels for the body. In short proteins, carbohydrates and fats, are the three nutrients which serve as fuels for our body. Out of these three nutrients fats give the maximum energy. Because as you know 1 gram of either protein or carbohydrate gives 4 calories on oxidation in the body, whereas 1 gram of fat gives 9 calories. Besides giving energy fats also serve as carriers of fat soluble vitamins, A D E K. This means that vit. A, D, E and K will not be utilized by our body when our diets lack in fats; and if vit. A, D, E and K are not utilized by our body many important functions would not be carried out in the body. In short, the function of vit. A is to keep the eyes healthy, that of vit. D is to help the growth of bones and to keep them strong. That of vit. E is to help the process of reproduction and lastly the function of vit. K is to help the co-agulation of blood, whenever it oozes out of the body. So you can imagine how much our body would suffer if fat is not taken in our daily diets. Besides giving energy and serving as the carrier of fat soluble vitamins A, D, E, K; fat is also needed to keep the skin healthy. The fourth function of the fat is that it increases

the satiety value of our meals which means fat present in our meals prevents the early return of hunger, because it remains in the stomach for a long time. In other words we would not feel hungry for a long time if enough fat is present in our meals. So, in short the four functions of fats are (i) to give energy, (ii) to serve as the carrier of the fat soluble vitamins, (iii) to keep the skin healthy, and (iv) to increase the satiety value of meals. Learning the functions of fats, you must have realized the importance of fats in our meals. So try to include enough fat in your daily meals, as it would harm your bodies, if your daily diets totally lack in fats. This fact needs emphasis as the present trend amongst the adolescent girls, is to completely avoid fatty foods in order to remain slim and thin, but you see, that is not advisable. On the other hand if you take excess of fat, as told before, you will be a round person with sometimes a heart trouble. So do decide to eat just the enough quantity of fats daily.

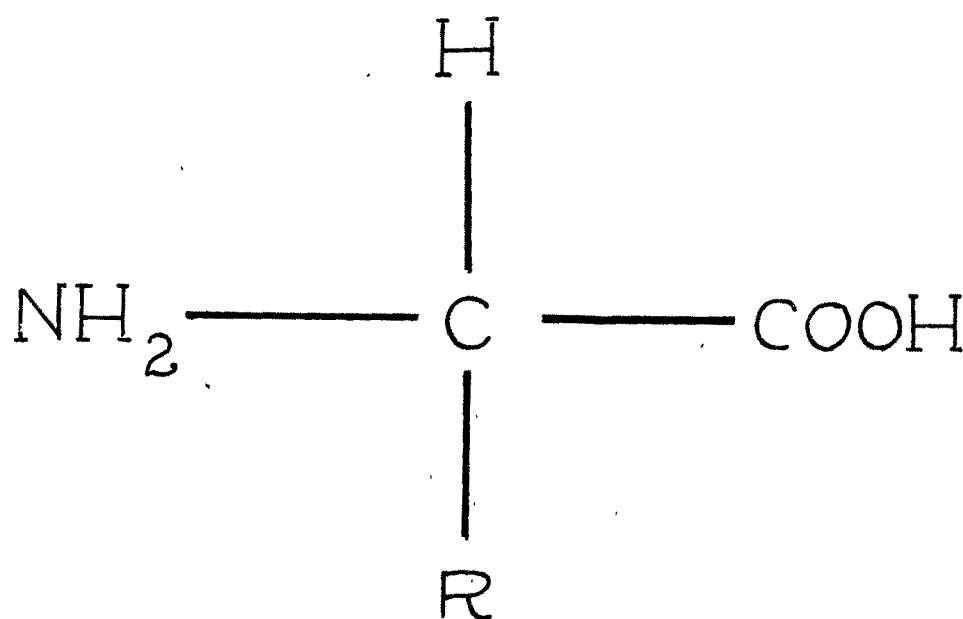
Let us recall a few more points by answering the following questions in your work sheet. Please be quick.

- Q.1 What is the recommended allowance of fat? State the two ill effects caused by the consumption of excess of fatty foods?
- Q.2 Say which are the very rich, rich, fair and poor sources of foods, mentioned in the below given list.
- Jaggery, cashew nuts, milk cream, sugar, butter, carrots, til oil, brinjals, bajra, green gram, ground nuts, apple.
- Q.3 State in brief the four functions of fats.

1

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AN AMINO ACID



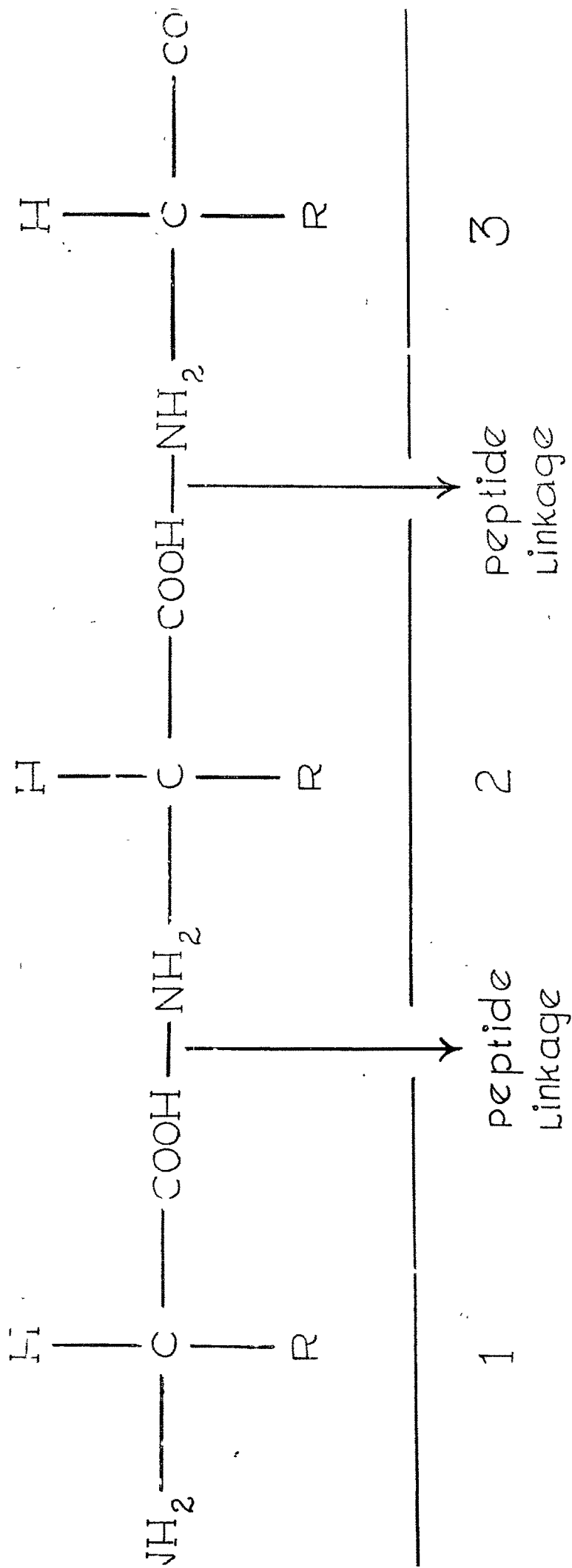
NH₂ = Amino group = Basic group.

COOH = carboxyl group = Acid group.

H = Hydrogen.

R = Rest of the structure.

2



3

4 4 8

NO of amino-acids	compound formed
Two	Di-peptide
Three	Tri-peptide
Four	Tetra-peptide
Five	Penta-peptide
Six	Hexa-peptide
seven	Hepta-peptide
More than seven	Poly-peptide

Essential Amino Acids.

- | | |
|-----------------|--------------------|
| 1. Leucine. | 6. Isoleucine. |
| 2. Lysin. | 7. Methionine. |
| 3. Tryptophane. | 8. Phenyl alanine. |
| 4. Threonine. | 9. Arginine. |
| 5. Valine. | 10. Histidine. |

Non-essential Amino Acids.

1. Glutamic acid.
2. Aspartic acid.
3. Alanine.
4. Proline.
5. Hydroxy proline.

5 SOURCES

450

RICH SOURCES:- complete proteins



Liver



Milk



Eggs & Poultry



Meat



Fish

FAIR SOURCES:- Incomplete proteins



vege. & Fruits

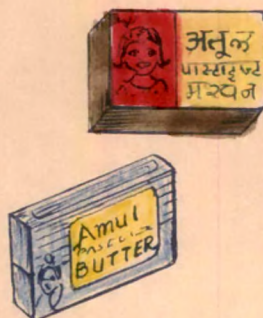


cereals



Pulses-nuts oil-seed

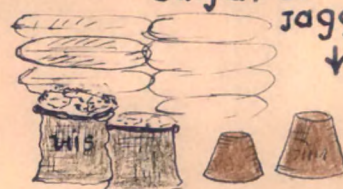
POOR SOURCES:-



Fats & oils



sugar & jaggery
↓

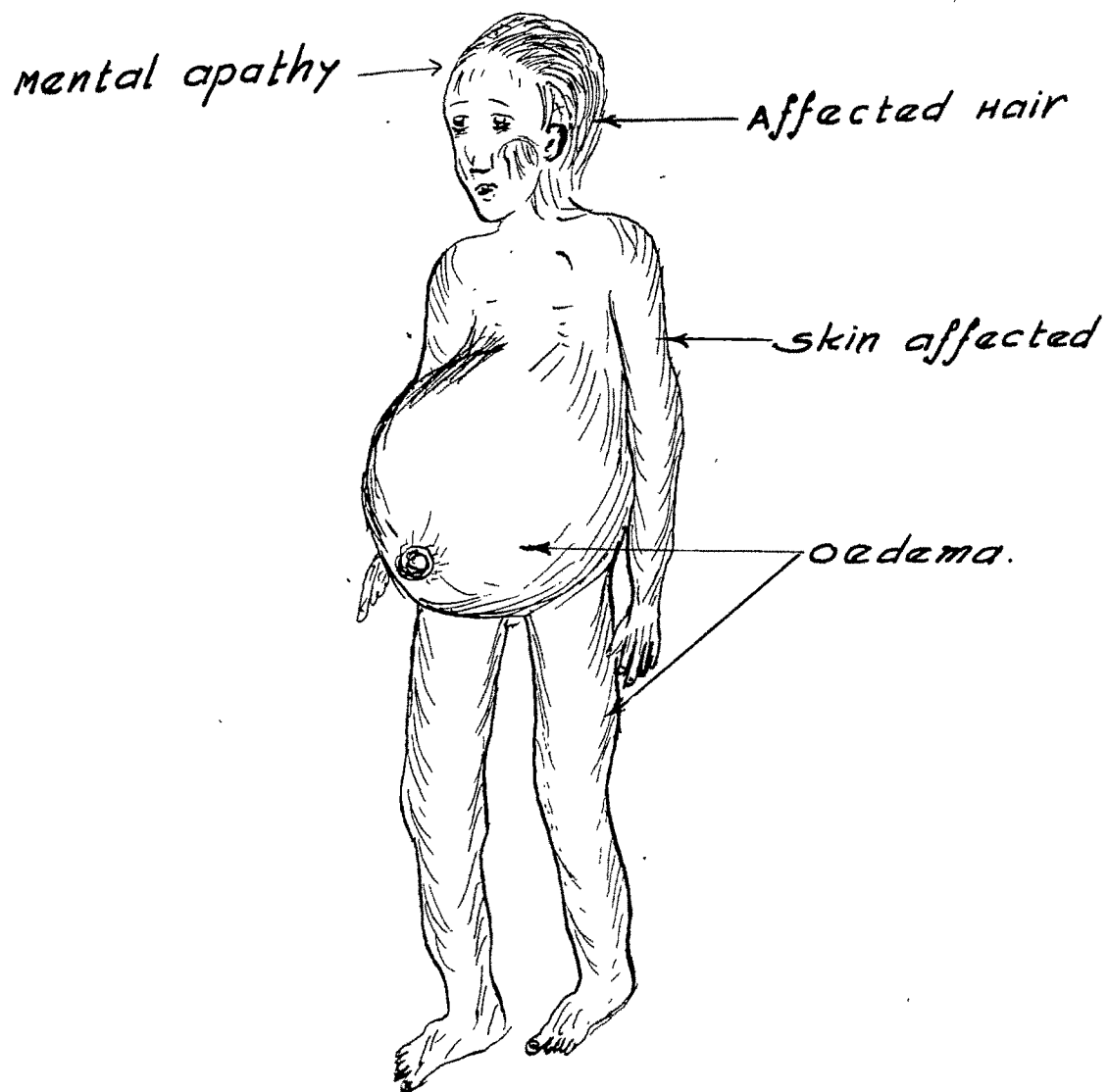


<u>Food</u>	<u>Name of Protein</u>
Wheat	Gluten
Maize	Zein
Milk	Casein
Meat	Myosin
Egg	Albumin
Pulse	Legumin

7

452

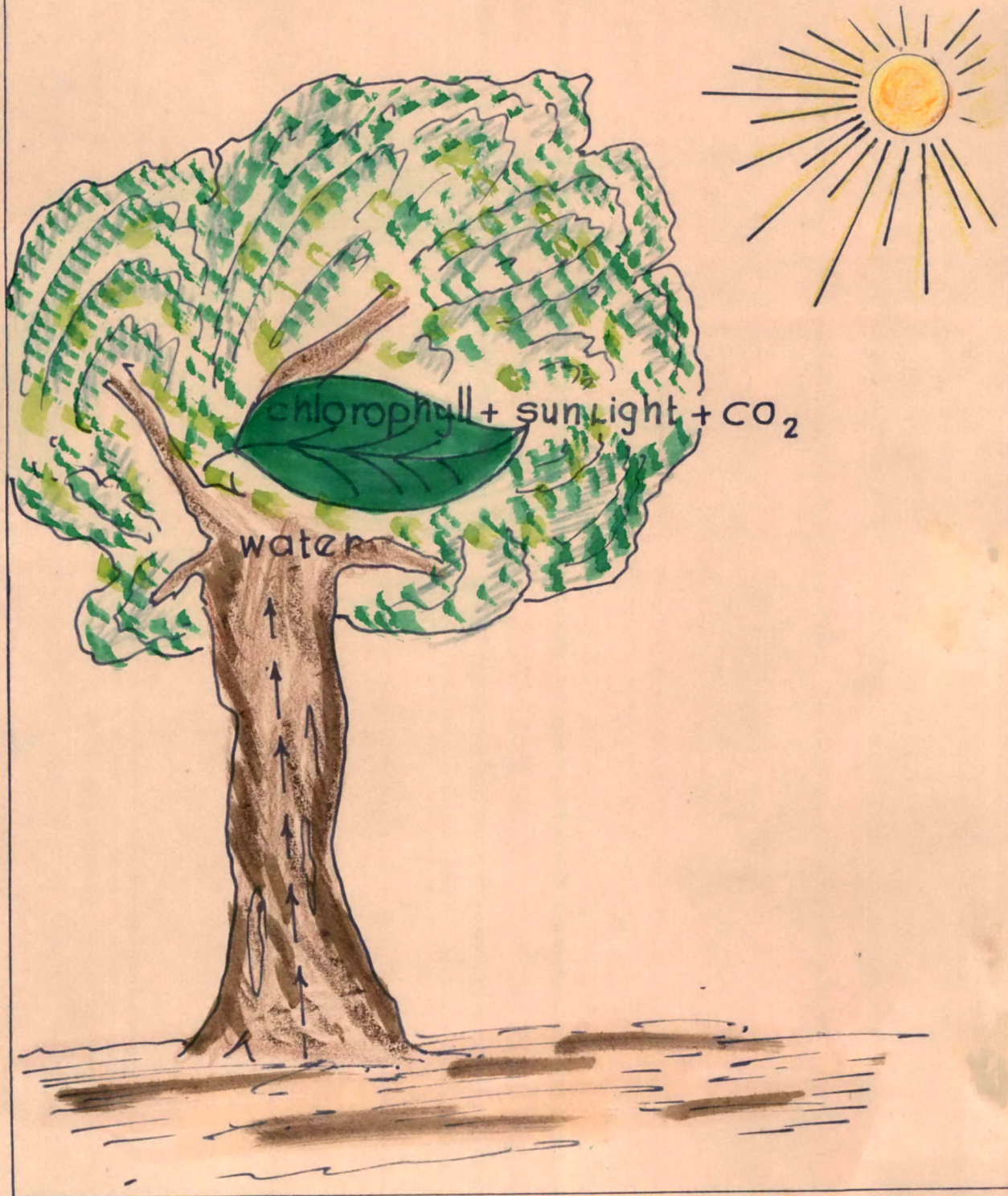
KWASHIORKOR



1

453

photosynthesis



Sources of CHO

Richest sources



honey મધ



sugar સુક્ર



jaggery ગોળ

Rich sources cereals



sweetcorn
મકાઈ



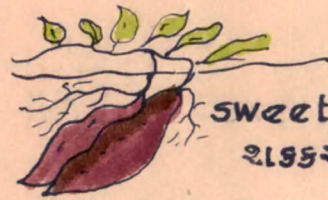
wheat
ઘઉં



Rice
ચોખા



Millet
જાજરી



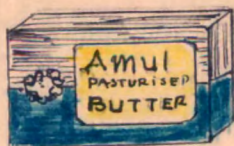
sweet potato
શાકરીયાં



potato
જાડાં

Root veg.

Poor sources



Butter માખણ



oil તેલ



ghee ઘી



oils

3

455









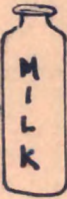


kinds of carbohydrates.

1. Mono-saccharides.
2. Di-saccharides.
3. Poly-saccharides.

4

456

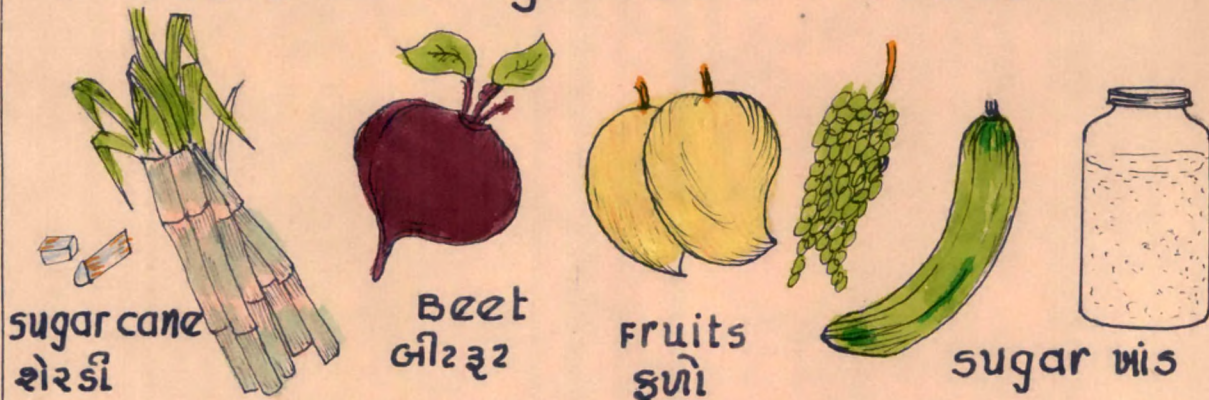
Mono-saccharides

Eg.	sources.
1. Glucose	 Blood  Fruits  cereals  vege.
2. Fructose.	 Honey  Fruits  vege.
3. Galactose	    Milk

di-saccharides:-

names composition & sources

1. sucrose = glucose + Fructose

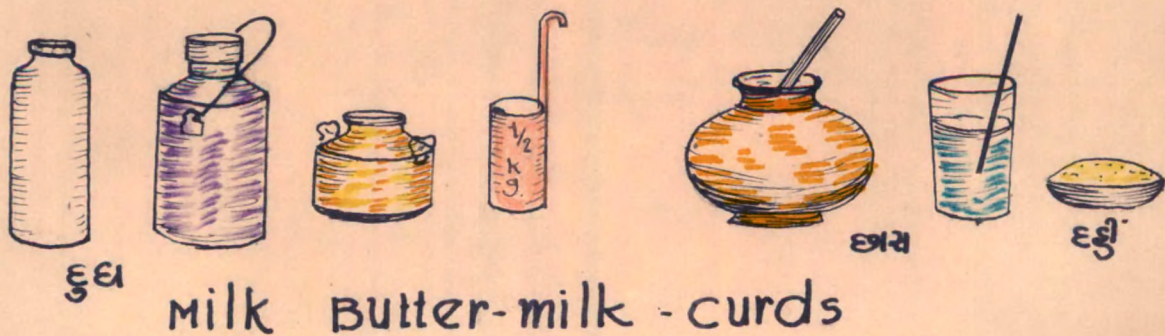


2. Maltose = glucose + glucose



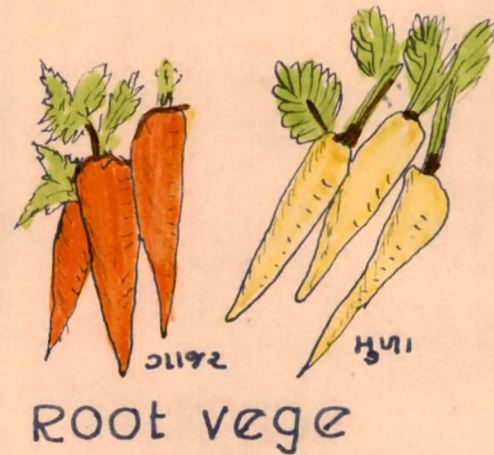
malted cereals.

3. Lactose = glucose + galactose

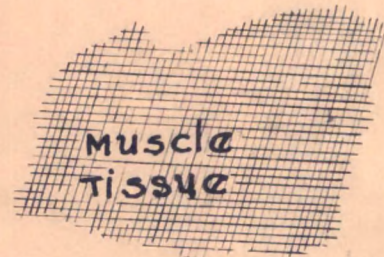


poly saccharides.

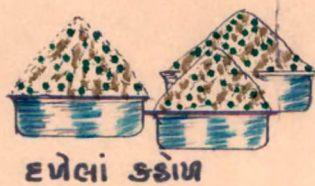
1. starch



2. glycogen



3. cellulose



outer skin of pulses cereals
and of vegetables.

Digestion

sucrose sucrase → glu + fruc.

maltose maltase → glu + glu.

lactose lactase → glu + galac.

[cooked] starch ptylin → maltose

cooked or raw starch Amylopsin → maltose



maltose

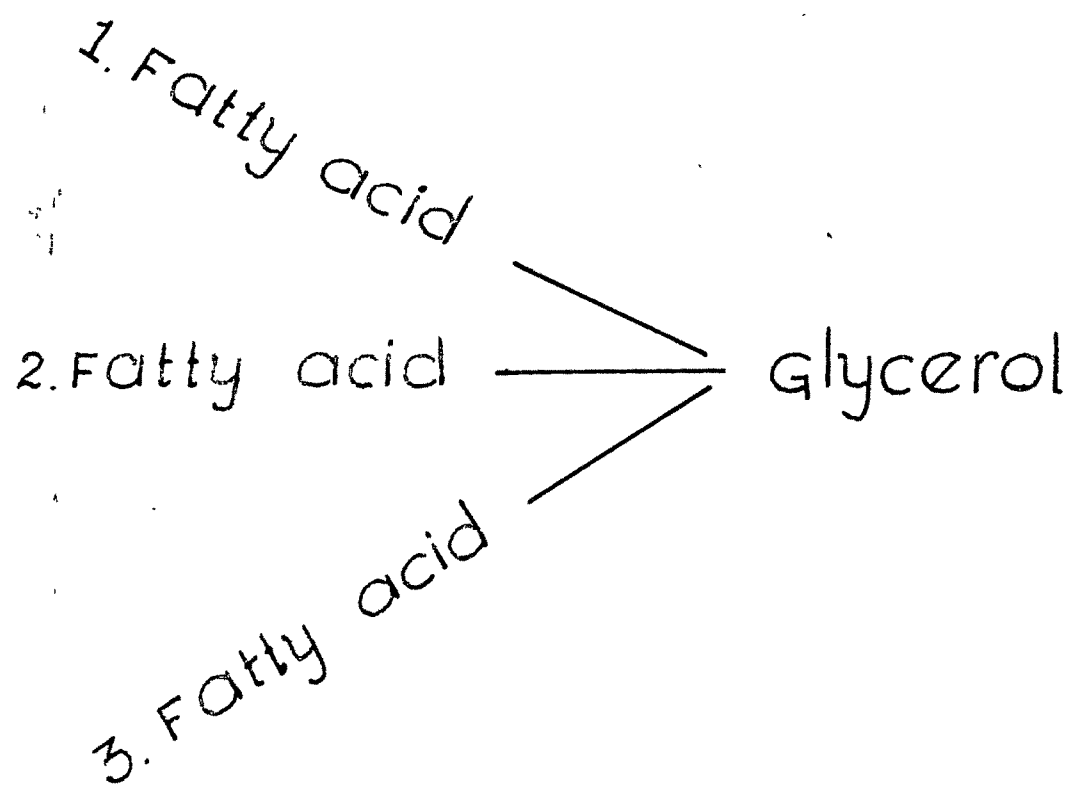


glucose

(Appendix E₃)
Charts on Fats.

1		460
VEGETABLE OILS		SOURCES
1. groundnut oil 2. gingelly seeds oil 3. coconut oil 4. soyabean oil 5. corn oil 6. Mustard oil 7. cotton-seed oil 8. sun flower oil		1. ground nuts 2. gingelly seeds 3. coconuts 4. soyabeans. 5. corns. 6. Mustard seeds 7. cotton-seeds 8 sun flowers.
ANIMAL FATS		SOURCES
1. Pure ghee 2. Butter 3. Lard 4. Tallow		1. Milk 2. Butter 3. Pork 4. Beef.
VEGETABLE GHEES		SOURCES
balda, rasad, pakao.		vegetable-oils

Basic Unit of Fat.



same
chemical
composition

oils = fats
3 fatty acids + glycerol

same
physical
properties



1. Lighter than water
2. Does not mix with water

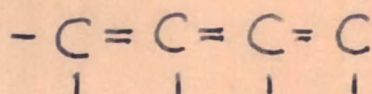
same
culinary
role

1. To bring out flavour
2. To produce good texture
3. To help both.

Difference BetweenOILS

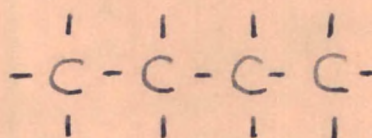
1. Liquid
at room temp.

2. unsaturated
compounds

FATS

1. solid
at room temp.

2. saturated
compounds



5

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RANCIDITY

1. MICROBIAL
RANCIDITY →



OPEN
FAT TIN

2. OXIDATIVE
RANCIDITY →



copper or iron
spoon in oil



Ghee attacked
by sun light.

3. HYDROLYTIC
RANCIDITY



over heating



repeated
heating

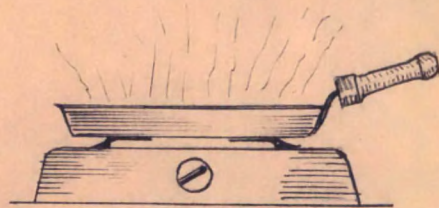
METHODS OF FRYING

DEEP FRYING



1. Deep frying pan

SHALLOW FRYING



shallow frying pan

2. Lot of oil.


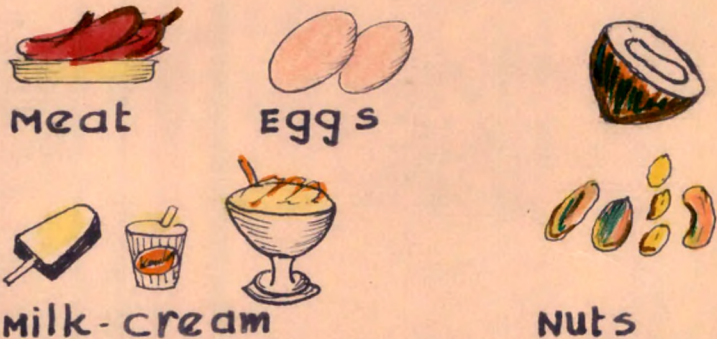
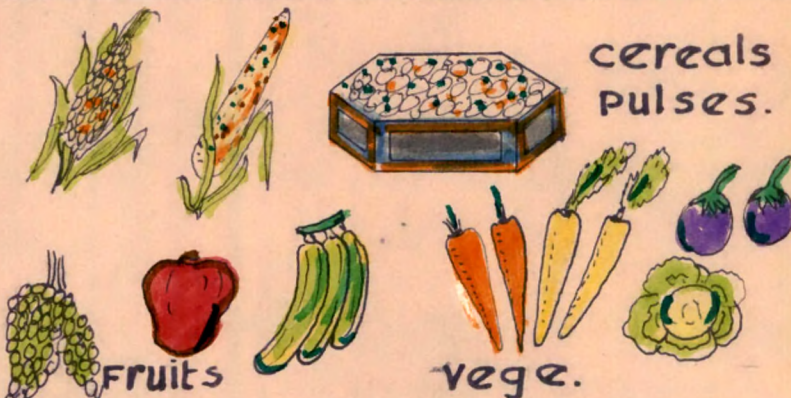

a little oil or fat.

3. High temp.

low temp.

4. Long frying time

short frying time.

Fat	sources
<p>very rich sources of Fat. →</p>	 <p>Fats and oils</p>
<p>Rich sources of Fat →</p>	 <p>meat Eggs Nuts</p> <p>milk-cream</p>
<p>Fair sources of Fat →</p>	 <p>cereals pulses.</p> <p>Fruits vege.</p>
<p>Poor sources of Fat →</p>	 <p>sugar & Jaggary Honey</p>

(Appendix F₁)

Unit I

PROTEINS

(Work-Sheet)

Q.1 What is the meaning of the term protein? Why it is important to have proteins in our daily meals?

Q.2 Why proteins are called nitrogenous substances?
_____.

Q.3 a) What is an Amino Acid?

b) Why it is called so?

c) Write down its formula.

--- XX ---

Q.1 Which linkage joins each two amino acids in a protein molecule? _____

Show the five linked up amino acids.

Q.2 Say the number of amino acids present in the following compounds. (i) Tetrapeptide _____, (ii) Hexa peptide _____, (iii) Hepta peptide _____.

Q.3 From the following list of amino acid sort out the essential and non-essential amino acids.

(i) Tryptophane _____ (ii) Lysine _____

(iii) Alanine _____ (iv) Methionine _____

(v) Aspartic Acid _____.

- Q.4 (a) Which are the two kinds of proteins? (i) _____,
(ii) _____.
- (b) Why they are called so?
- (c) List atleast two foods which contain each kind of protein.

--- XX ---

- Q.1 Explain in few lines what you understand by the proteins of high and low biological value?
- Q.2 Define supplementary value of protein and explain in detail why plant proteins need to be supplemented.
- Q.3 Which of the following groups of foods are rich, fair and poor sources of protein?

Group (a)	Group (b)	Group (c)
Sugar	Mango	Egg
Jaggery	Bengalgram	Meat
Til oil	Wheat	Fish
Ghee	Brinjal	Milk
Butter	Cashewnuts	Liver
	Ground nuts	

--- XX ---

- Q.1 Mention the names of proteins for the foods given below.
 (i) Milk _____, (ii) Egg _____, (iii) Wheat _____,
 (iv) Maize _____, (v) Pulses _____, (vi) Meat _____.
- Q.2 State the recommended allowance of protein for man _____,
 woman _____, and a seven year old child _____.
- Q.3 State in brief the four functions of proteins.
 (i) _____ (ii) _____
 (iii) _____ (iv) _____

--- XX ---

- Q.1 What is the right age when a child should be given
 semi-solid foods along with milk? _____
 What do you call this period? _____
- Q.2 What is the name of the protein deficiency disease?

- Q.3 Which are the two factors responsible for causing this
 disease? (i) _____ (ii) _____.

--- XX ---

- Q.1 Please understand the following situation and answer the
 following questions.

Suppose your neighbour's eight months old child having
 straight, sparse and grey coloured hair, looks very plump
 although too light in weight and is least interested in
 surroundings. It often vomits and also passes stools
 number of times.

From your knowledge about these external signs, can you
 say that the child is suffering from any disease? _____

If yes, which disease? _____

Which nutrient is deficient? _____

List any two protein-rich, semi-solid food preparations
which can help to cure the disease. (i) _____
(ii) _____

— XX —

(Appendix F₂)

Unit II

CARBOHYDRATES

(Work - Sheet)

Answer the following questions:

Q.1 What are carbohydrates composed of?

Q.2 Explain the term carbohydrates.

Q.3 What prepares the carbohydrates and how?

--- XXX ---

Q.1 Which is the process, by which, plants prepare carbohydrates? _____

Q.2 What is the main function of carbohydrates? _____

Q.3 How many calories are produced when one gram of carbohydrates burns in the body? _____

--- XXX ---

Q.1 Approx. how many grams of CHO, one must take in the daily diet and how many calories can be obtained from that quantity? _____.

Q.2 Here are the names of 4 foods, 1. Jowar, 2. Potato, 3. Jaggery, 4. Pure ghee. Say which is the very rich; rich and poor sources of CHO? _____

--- XXX ---

- Q.1 Which are the three main kinds of carbohydrates?
 _____, _____, _____.
- Q.2 Why honey is very sweet?
- Q.3 Which is the blood sugar and what is its blood level?
 _____, _____.
- Q.4 Name the kind of mono-saccharide present in the following:
 Ripe Mango, immature wheat, milk.
- Q.5 Why glucose is given to sick people?

--- XXX ---

- Q.1 Here below are the three pairs of mono-saccharides.
 Guess correctly which di-saccharides result from each
 of these.
- a) Glucose + glucose =
- b) Glucose + galactose =
- c) Glucose + fructose =
- Q.2 Suppose you had the following foods in your lunch
 yesterday. Name the di-saccharide present in each.
 Malted wheat gruel, curds, sweet banana.

--- XXX ---

- Q.1 Which poly-saccharide you can get from each of the
 following foods?
- a) Peels of brinjals, cucumber, potatoes. _____
- b) Outer coating of green gram. _____
- c) Yam and sweet potato. _____

- Q.2 Which poly-saccharide is not found in foods? and where it is stored in the body?
- Q.3 Which poly-saccharide is thrown out of the body without being digested? Why it is so? What is the disadvantage if it is absent in our meals?
- Q.4 Which poly-saccharide undergoes digestion? _____

--- XXX ---

- Q.1 Analysis of which two body fluids help you to know the presence or absence of diabetes and how?
- _____

- Q.2 Mention two chief causes of diabetes.

- Q.3 How can you control diabetes with foods?

--- XXX ---

(Appendix F₃)

Unit III

FATS

(work sheet)

Q.1 Name the sources of the following oils and fats.

- (i) Gingelly seed oil :
- (ii) Soyabean oil :
- (iii) Tallow :
- (iv) Dalda :

Q.2 Give reasons for the following:

- (i) Dalda, Pakao etc. are called vegetable ghees.
- (ii) Edible oils like coconut oil, groundnut oil etc. are called vegetable oils.
- (iii) Pure ghee, lard and tallow are referred to as animal fats.

--- XXX ---

Q.1 How do fats differ from carbohydrates as far as their chemical composition is concerned?

Q.2 State the number of fatty acids and glycerole molecule which together form the basic unit of fat.

Q.3 Explain in a line -

"The chemical composition of fats and oils is similar".

--- XXX ---

Q.1 Justify the following statement.

"Fats and oils have the same physical properties and the culinary role."

Q.2 What is the chief difference between fats and oils?
What is this difference due to?

--- XXX ---

Q.1 Name and explain the process by which vegetable oils are converted to saturated fats. Also state the advantage of it.

Q.2 When can you say that fats and oils are rancid?

--- XXX ---

Q.1 Which are the three kinds of rancidities? Discuss in brief, how each kind of rancidity develops.

Q.2 Explain the following terms:

- (a) Smoke point
- (b) Over heating
- (c) Repeatedly heating

Q.3 Why satisfactory frying is not helped if fats or oils are over heated or underheated?

--- XXX ---

Q.1 State the 4 main differences between the two methods of frying.

Q.2 Why oils are used for deep frying and fats are used for shallow frying?

Q.3 (a) What leads to lowering of the smoke point?

- (b) Write down how much of fat proteins, carbohydrates, vitamins and minerals, you would get from 50 gms. of groundnut oil, used, to prepare your full day meal.

--- XXX ---

- Q.1 What is the recommended allowance of fat? State the two ill-effects caused by the consumption of excess of fatty foods.

- Q.2 Say, which are the "very rich" "rich", "fair" and "poor" sources of foods, mentioned in the below given list.

Jaggery, cashew nuts, milk-cream, sugar, butter, carrots, til oil, brinjals, bajra, green gram, groundnuts and apples.

- Q.3 State in brief the 4 functions of fats.

--- XXX ---

(Appendix G₁)

: LABORATORY DEMONSTRATIONS :

(laboratory demonstrations were used in all the three strategies)

Unit I

(PROTEINS)

Objective (i) : To show the rich, fair and poor sources of proteins using the real, locally available foods.

Foods Displayed with labels:

(a) Rich sources of proteins:

- (i) Meat, (ii) Eggs, (iii) Liver, (iv) Fish,
- (v) Chicken, (vi) Milk.

(b) Fair sources of proteins:

- (i) A few cereals, (ii) a few fruits, (iii) a few vegetables.

(c) Poor sources of proteins:

- (i) Sugar, (ii) Jaggery, (iii) Groundnut oil,
- (iv) butter.

Next, pointing out to a labelled set of different nuts and pulses, the teacher explained that many of these pulses contain more amount of protein than the above mentioned non-vegetarian foods, but yet these cannot be categorized as rich sources of proteins as they lack in the quality, i.e. the quality of pulse-protein is not as superior as that of the non-vegetarian foods listed above. Teacher also made it clear that no fat or oil would ever contain any protein.

Objective (ii) : To show the foods bearing complete proteins.

Teacher pointed out to the foods labelled as 'Rich sources of proteins' to explain that 'these are the foods bearing complete protein'.

Objective (iii) : To show the foods bearing incomplete proteins.

Teacher pointed out to the foods, labelled as 'Fair sources of proteins' and to the set of nuts and pulses; to explain that these are the foods which contain incomplete proteins.

Objective (iv) : To show how to supplement plant proteins judiciously to improve the quality of proteins using real cereal-pulse mixtures.

Foods Displayed with labels:

- (a) Wheat + Bengalgrams
- (b) Kodari + Peas

Teacher showed the above plant-protein mixtures, to explain how protein quality can be improved by consuming cereal and pulse mixtures at a time.

Objective (v) : To show the child suffering from 'Kwashiorkor' - the protein deficiency disease.

A child suffering from the protein deficiency disease called Kwashiorkor, was brought to the laboratory from one of the slum areas of Baroda city. The students were explained the symptoms of the disease showing the same child.

(Appendix G₂)

: LABORATORY DEMONSTRATIONS :

Unit II

(CARBOHYDRATES)

Objective (i) : To show the concentrated (very rich), rich, fair and poor sources of carbohydrates, using real, locally available foods.

Food Displayed with labels:

(a) Very rich sources of carbohydrates:

(i) Sugar, (ii) Jaggery, (iii) Honey.

(b) Rich sources of carbohydrates:

(i) A few cereals, (ii) A few root-vegetables.

(c) Fair sources of carbohydrates:

(i) Pulses and nuts, (ii) Fruits, and
(iii) Vegetables.

(d) Poor sources of carbohydrates:

(i) Ground-nut oil, (ii) Butter.

Teacher explained as to why some foods are referred to as very rich, some as rich, some as fair and some as poor sources of carbohydrates. Further it was also made clear that no fat or oil would contain any carbohydrates.

Objective (ii) : To show the sources of mono-saccharides, di-saccharides and poly-saccharides.

Food Displayed with labels:

(1) Mono-saccharides:

(a) Glucose : Glucose powder, Immature cereals.

(b) Fructose : A few fruits

(c) Galactose : Milk

(2) Di-saccharides:

- (a) Sucrose : Table sugar, beet-root, sugar-canes.
- (b) Maltose : Malted cereals
- (c) Lactose : Milk

(3) Poly-saccharides:

- (a) Starch : Rice, Potato
- (b) Cellulose : Leafy vegetables, cucumber.

Objective (iii) : To show the foods to be avoided in diabetes.

Foods Displayed with labels:

- (i) Cake, (ii) Chocolates, (iii) Fanta, (iv) Fritters,
- (v) Rice, (vi) Potatoes, (vii) Custards, (viii) Chikies.

Pointing out to these foods, teacher explained that sweet dishes, cereals, root vegetables and fried foods are to be avoided in the disease diabetes.

Objective (iv) : To show the foods to be advised in diabetes.

Foods Displayed with labels:

- (i) Fermented foods like idlies and Handwa (Indian Cake), (ii) boiled egg, (iii) boiled meat, (iv) milk,
- (v) sprouted pulses, (vi) bread, (vii) citrous fruits, and (ix) leafy vegetables.

Teacher, pointing to the above set of foods, discussed as to why the above listed foods should be included in a diabetic patient.

(Appendix G₃)

: LABORATORY DEMONSTRATIONS :

Unit III

(FATS)

Objective (i) : To show the physical properties of fats and oils.

Foods and materials used:

Two troughs of water, 1 tea-spoon of butter, 1 tea-spoon of groundnut oil.

Teacher put 1 tea-spoon of butter in one of the troughs containing water, and poured 1 tea-spoon of ground-nut oil in another trough of water. Next, teacher asked the students to record their observations. Following this, the teacher concluded, with the help of students that (i) fats and oils are lighter than water as both are found on the surface of the water; and (ii) fats and oils do not mix with the water as these are seen separately in the water. The students were further told to record these two properties as the physical properties of fats and oils.

Objective (ii) : To show the situations leading to different kinds of rancidities.

Conditions Displayed:

- (1) Open dalda tin containing ghee was placed in the laboratory where it was attacked directly by the sunlight.
- (2) Dalda tin was placed in the moist area.
- (3) A copper-spoon was immersed into a jar filled with oil.

- (4) Open oil tin, containing ground-nut oil was placed in the laboratory.

Teacher explained about each condition leading to a particular kind of rancidity in fats.

Objective (iii) : To show under-heating, over-heating and heating to the smoke-point.

Teacher demonstrated what is under-heating, over-heating and heating to the smoke point, by frying a puri, in a deep Kadhai, filled half, with oil.

To show the effect of under-heating, the teacher fried puri, in the oil which was not allowed to be heated enough. The students recorded their observations as (i) puri was not fried properly although the time taken for frying was very long, and (ii) it absorbed a lot of oil.

To show the effect of over-heating the teacher fried a puri, in oil which was heated excessively. The students recorded their observations as (i) puri got burnt immediately.

To show the effect of heating to the smoke-point, the teacher fried a puri in the oil which was just sufficiently heated till the visible fumes began to come out. The students made their observations as (i) puri was fried properly, (ii) it did not absorb lot of oil, and (iii) the time taken for frying was either not too long or too less.

Objective (iv) : To demonstrate the chief differences in frying methods.

The teacher demonstrated the differences in two methods of frying namely, (i) deep frying, and (ii) shallow frying, by frying dahi-vadas in a deep Kadhai containing lot of oil and an egg omlet in a shallow pan containing a little dalda. The students recorded the differences between the two methods of frying in two columns as follows:

Deep Frying

1. Need a deep container
2. Need a lot of oil.
3. Time taken for frying is long.
4. Generally oils are only used as they have high smoke point.

Shallow Frying

1. Need a shallow container.
2. Need a little fat.
3. Time taken for frying is less.
4. Either oils or fats are used.

Objective (v) : To show the very rich, rich, fair and poor food sources of fats using real, locally available foods.

Foods Displayed with labels:

- (a) Very rich (concentrated) sources of fats:
 - (i) A few varieties of cooking oils, (ii) pure ghee and (iii) butter.
- (b) Rich sources of fats:
 - (i) Nuts - Almonds, cashewnuts, pival seeds, pistachio nuts.
 - (ii) Oil-seeds - Gingelly seeds and Groundnuts.
 - (iii) Milk-cream, (iv) eggs, (v) Khoa.
- (c) Fair sources of fats:
 - (i) Fruits, (ii) Vegetables, (iii) Cereals.
- (d) Poor sources of fats:
 - (i) Sugar, (ii) Jaggery, and (iii) Honey.

The teacher explained as to why different foods are categorized as very rich, rich, fair and poor sources of fats.

(Appendix H)

LIBRARY REFERENCE WORK

'Library Reference Work' was incorporated in strategy two (S₂).

The names of the following books were suggested, with the chapter numbers for each unit.

- (i) Swaminathan M. and Bhagavan R.K. (1976), Our Food; Ganesh and Co. (Madras) Private Limited, Madras.

Chapter : III - Unit 1 - Proteins

Chapter : IV - Unit 2 - Carbohydrate

Chapter : V - Unit 3 - Fats

- (ii) Davidson, S. and Passmore, R. (1975), Human Nutrition and Dietetics; The William and Wilkins Company, Baltimore.

Chapter : V - Unit 1 - Proteins

Chapter : IV - Unit 2 - Carbohydrates

Chapter : VI - Unit 3 - Fats

- (iii) Proudfit, F.T. and Robinson, C.H. (1965), Normal and Therapeutic Nutrition; Oxford and IBH Publishing Co., Calcutta.

Chapter : IV - Unit 1 - Proteins

Chapter : V - Unit 2 - Carbohydrates

Chapter : VI - Unit 3 - Fats

(Appendix I)

DISCUSSION

'Discussion' was incorporated in strategy one (S_1) and strategy three (S_3)

The points, decided to have discussion on, from the three selected units, are as under:

Unit : 1 - Proteins

1. Kinds of amino acids
2. Recommended allowance
3. Functions of proteins
4. Effect of protein deficiency on adults.

Unit : 2 - Carbohydrates

1. Process of photosynthesis
2. Recommended allowance
3. Carbohydrates that need digestion and carbohydrates which do not undergo digestion.
4. Blood-glucose level.

Unit : 3 - Fats

1. Different kinds of fats and oils
 2. Process of hydrogenation
 3. Obesity
 4. Functions of fats.
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