

## **COURSE GUIDE**

### **PHS 202 NUTRITION IN HEALTH AND DISEASES**

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## **INTRODUCTION**

Nutrition in Health and Diseases is a second semester course. It is a three credit degree course available to all students offering Bachelor of (B.PHS.) Public Health Science (PHS).

Nutrition is one of the essential keys to developing and maintaining quality health through the life cycle. Poor dietary intakes coupled with a sedentary lifestyle on the other hand, have been associated with life threatening non communicable chronic diseases and death.

Nutrition in Health and Disease is a course that describes the importance of nutrition in attaining optimal health, productivity, healthful reproductive system, freedom from infections and non-infectious diseases, industrial, social and mental developments.

The course also expatiates the knowledge and skills in nutrition and their applications in improving dietary habits of not only the learners but also their clients, friends, families, and public at large through nutrition education in food budgeting, purchasing, preparation and presentation. The course also discusses application of nutrition principles in the management of clients suffering from Protein Energy Malnutrition (PEM), hypertension and adult diabetes mellitus (Type 2). Finally, the roles of nutrition and genetics in human health as well as the development of chronic diseases such as cancer, osteoporosis, diabetes and cardiovascular disease are discussed.

## **COURSE AIM**

The overall aim of this course is to increase the knowledge and skills of learners in nutrition and its application to developing and maintaining health through life cycle. Other aims include providing for the learners understanding of basic nutrition and application of this basic knowledge in nutrition to solving diet related health problems.

## **COURSE OBJECTIVES**

In an attempt to achieving the above aims, the course has a set of objectives. Each unit has specific objectives which are included at the beginning of the unit. You should read these objectives before you study the unit. You may wish to refer to them during your study to check on your progress. You should always examine the unit objectives after completion of each unit. By doing so, you would have followed the instruction in the unit. Below are the comprehensive objectives of the course as a whole. By meeting these objectives, you should have

achieved the aims of the course as a whole. In addition to above, this course sets to achieve objectives. Consequently, after going through the course, you should be able to;

- ? Define nutrition and other common terminologies in nutrition.
- Describe nutritional behavior of Homo sapiens before and after agricultural and industrial revolutions.
- Demonstrate the knowledge of basic nutrition in food composition. Identify major nutrient requirements through life cycle.
- Describe the application of nutritional knowledge in food purchasing, preparation and presentation.
- Identify at least three locally available foodstuffs in the preparation of complementary feeding.
- List three methods of assessing the nutritional status of an individual or that of a community.
- Demonstrate at least two methods of improving the nutrition intake of a community.
- Demonstrate the application of nutritional knowledge and principles in the care of protein-energy malnutrition, hypertension and diabetes.
- Describe the concept of nutritional genomics.

## **WHAT YOU WILL LEARN IN THIS COURSE**

The course consists of modules with units and a course guide. This course guide briefly discusses what the course is about, what course materials you will be using and how you can work with these materials. In addition, it advocates some general guidelines for the amount of time you are likely to spend on each unit of the course in order to complete it successfully.

It gives you guidance in respect of Tutor-Marked Assignments which will be made available in the assignment file. There will be regular tutorial classes that are related to the course. It is advisable for you to attend these tutorial sessions. The course will prepare you for the challenges you will meet in the field of basic nutrition.

## **WORKING THROUGH THIS COURSE**

To complete this course you are required to read each study unit, read text books and read materials which may be provided by the National Open University of Nigeria. Each unit contains self-assessment exercise and at certain points in the course you would be required to submit assignments. At the end of the course there is a final examination. The

course should take you about a total of 17 weeks to complete. Below you will find listed all the components of the course, what you have to do and how you should allocate your time to each unit in order to complete the course on time successful. This course entails that you spend a lot of time to read. You are advised to make yourself available to participate in the online tutorial sessions where you will have the opportunity of comparing your knowledge with that of other learners.

## **COURSE MATERIALS**

The main components of the course are:

1. The Course Guide
2. Study Units
3. References/Further Readings
4. Assignments
5. Presentation Schedule

It cannot be overemphasized that you must obtain the text materials. These texts, mostly, are provided by NOUN (Study Centres). You are advised to purchase recommended texts on your own at bookshops. In case you have any difficulty, please contact your Facilitator of the course in your Centre.

## **STUDY UNITS**

There are 24 study units in this course, and they are as follow:

### **Module 1 Nutrition and its Historical Perspectives**

- |        |  |
|--------|--|
| Unit 1 | Introduction to Nutrition                                  |
| Unit 2 | Notable Names in the Beginning of the Study of Nutrition   |
| Unit 3 | Focus of Nutrition Research in Early Century Till Present. |
| Unit 4 | Food and Culture   |

### **Module 2 Basic Knowledge in Nutrition**

- |         |                        |
|---------|------------------------|
| Unit 1  | Carbohydrates          |
| Unit 2  | Proteins               |
| Unit 3  | Lipids (Fats and Oils) |
| Unit 4: | Minerals and Vitamins  |
| Unit 5: | Water and Fiber        |

**Module 3 Food classification, purchasing, preparation, presentation and complementary feeding**

- Unit 1 Food Classification
- Unit 2: Food Purchasing
- Unit 3 Food Preparation
- Unit 4 Food Presentation
- Unit 5 Preparation of Complementary Feeding for young children

**Module 4 Assessment of Nutritional Status, Nutrition Education, Nutritional Care in Disease, Nutritional Care for Protein-Energy Malnutrition, Diabetes, and Hypertension**

- Unit 1 Assessment of Nutritional Status
- Unit 2 Nutrition Education
- Unit 3 Nutrition Care in Disease
- Unit 4 Nutrition Care for Protein Energy Malnourished Children
- Unit 5 Nutrition Care for Hypertensive and Diabetic patients

**Module 5 Nutritional genomics**

- Unit 1 Concept of Nutrigenomics
- Unit 2 Rationale for Nutrigenomics
- Unit 3 Genetic Variations
- Unit 4 Bioactive Food Component and Dietary Fat
- Unit 5 Nutrigenomics in relation to Nutrigenetics

Each unit contains a number of self-assessment tests. In general, these tests are based on the units you have covered while reading. They are meant to guide your reading and assess you on how you have been able to understand the materials you have just read. Do the Tutor-Marked Assignment on your own. This will assist you in achieving the stated learning objectives of the individual units and the overall course.

The first Module is about nutrition and its historical perspective. The first unit introduces nutrition by defining key terminologies in the study of nutrition and describes what an adequate nutrition means. The unit also examines ancestral human nutritional behavior before and after industrial revolution. The effects of such revolutions on human nutritional behaviors are also illustrated. Units two and three describe the notable names in the beginning of the study of nutrition and the significance of their contributions and focus of nutrition research in the first half century till present. The fourth unit in the model focuses on food and culture and factors influencing food habits or choices are also described.

The second module deals with basic knowledge in nutrition. Under this module, the five units explained the major compositions of food (carbohydrates, proteins, lipids, minerals, vitamins, water and fiber). The importance and functions of these nutrients are discussed.

The third module is all about food classification, purchasing, preparation, presentation and complementary feeding.

In module 4, the first unit discusses various ways of assessing the nutritional status of an individual or a community. The second unit deals with nutrition education methods and their effectiveness.

Units 3, 4 and 5 are concerned with the nutritional care in diseases such as protein energy malnutrition in young children, hypertension and diabetes mellitus in adults.

The goals of nutritional care and principles for planning a nutritious diet in each disease are discussed.

The fifth module is about nutritional genomics which is the role of nutrition and genetics in human health as well as the development of chronic diseases such as cancer, osteoporosis, diabetes and cardiovascular disease. The module comprises unit one to unit five which discussed the concept of nutrigenomics, rationale for nutrigenomics, nutrigenomics and disease risks, genetic variations, fate and activities of nutrients in the cell and nutrigenomics in relation to nutrigenetics respectively.

Each unit consists of one or two weeks' work and include an introduction, objectives, reading materials, exercises, conclusion, summary, Tutor-Marked Assignments (TMAs), references and other resources. The unit directs you to work on exercises related to the required reading. In general, these exercises test you on the materials you have just covered or require you to apply it in some way and thereby assist you to evaluate your progress and to reinforce your comprehension of the material. Together with TMAs, these exercises will help you in achieving the stated learning objectives of the individual units and of the course as a whole.

## **RECOMMENDED TEXTS**

The following text books are recommended:

- (i). King, MH, King, FM, Morley, DC, Burgess, HJC, and Burgess, AP. Nutrition for Developing Countries. Oxford University Press. 1982.



- (ii). Kittler, PG and Such, KP. Food and Culture, 4th ed. Thomson Wadworth, Canada, UK, USA, 2004.
- (iii). Oke, OL and Ojofeitimi, EO. Nutrition for Nurses. Longman Group Ltd., Churchill, Livingstone, Edinburge London and New York, 1984. 210pages.
- (iv). Ojofeitimi, EO, Principles and Practice of Nutrition for Public Health Practitioners. Nonesuchhouse, Ibadan 2009.
- (v). Smith, I.F. and Ojofeitimi, EO., Nutrition and Diet Therapy for Healthcare Professionals In Africa: Y-Books, Ibadan, Nigeria 1995, 204 pages.
- (vi) Garrow, JS, James, WPT, Ralph A, Human Nutrition and Dietetics: Churchill Livingstone, 10th edition, 2000.
- (vii) WHO Geneva, Trace Elements in Human Nutrition and Health: Macmillian/Ceuterick, 1996.

## **ASSIGNMENT FILE**

### **Module 1**

#### **Unit 1**

1. In your own words define the terms nutrition, food and micronutrients.
2. Enumerate the main differences between our ancestors' diet and the modern ones.

#### **Unit 2**

1. List 4 notable names in the study of nutrition and their contributions.
2. What are the linkages between the early pioneers of nutrition to present dietary behaviour?

#### **Unit 3**

1. Differentiate between nutrition research endeavors in the first half of 20th and 21st Centuries.
2. State three usefulness of nutrition research.

#### **Unit 4**

1. Using appropriate examples, define the terms staple food and food habits.
2. List four factors that influence food choices.

**Module 2****Unit 1**

1. List five functions of carbohydrates.
2. Discuss the journey of a piece of bread you have just taken in terms of its digestion.

**Unit 2**

- 1 a. Differentiate between classes of protein.  
b. List the essential amino acids for children and adults.
2. Briefly describe the differences between supplementary and complementary protein.

**Unit 3**

1. List five functions of fats
  - (a) Why is fat solid at room temperature?
  - (b) Give at least two examples each of fats and oils.

**Unit 4**

- 1a. Distinguish between macro and micro minerals.  
b. Describe the principal functions, two food sources and deficiencies of each of the macro and micro minerals.
- 2a. Differentiate between fat and water soluble vitamins.  
b. Which of the B vitamins are associated with energy and protein metabolism?

**Unit 5**

- 1 (i). Define water in your own words.  
(ii). State two classes of water.
  - b. Enumerate 5 functions of water.
- 2a. Describe the differences between starch and dietary fibers.  
b. With specific examples of food benefits and their classification, list three health benefits of dietary fiber

**Module 3****Unit 1**

1. List three methods of classifying foods with specific healthy available foodstuffs.

2. Name four groups in the Daily Food Guide Pyramid and identifying at least three food items of each group.

## **Unit 2**

1. List five determinants of food purchasing
2. How would you allocate the sum of ten thousand naira for food budgeting for a month for a family of four?

## **Unit 3**

1. Distinguish between two types of food preparation and their effects on the food nutrients.
2. What special precautions should be taken in preventing food borne illness in a family?

## **Unit 4**

1. Define food preparation in your own words.
2. Describe two of the human senses that may affect presentation.

## **Unit 5**

1. Differentiate between weaning and complementary feedings.
2. List three reasons for prescribing complementary feeding for infants aged 6 months and above.

## **Module 4**

### **Unit 1**

1. What is the difference between BMI and WHR?
2. A client's anthropometric data are: weight is 75kg, height is 1.75m, hip is 91cm and waist is 94cm based on the above, calculate the BMI and WHR.

### **Unit 2**

1. What is the difference between nutrition education and nutrition information?
2. List three barriers to effective nutrition education.

**Unit 3**

1. List four aims of diet therapy.
2. Differentiate between full liquid and soft fiber-restricted diets with specific disease condition.

**Unit 4**

- 1
  - a. Define Protein Energy Malnutrition (PEM).
  - b. What are the Patterns of PEM?
2. What are the Features of a marasmic patient?

**Unit 5**

- 1a. With specific example differentiate between mild and moderate hypertension.
  - b. Describe two aims of nutritional support for a hypertensive patient.
- 2a. what are the differences between Type 1 and Type II diabetes mellitus?
  - b. Describe the nutritional recommended plans for adult diabetic patients in your own words.

**Module 5****Unit 1**

1. Explain the term nutrigenomics.
2. What are the different elements of nutrigenomics?

**Unit 2**

1. Discuss the relevance of nutrigenomics in making dietary recommendation.
2. Why are some people healthier than others?

**Unit 3**

1. With appropriate example describe ways in which interaction between genetic and dietary influences can result in a higher risk of disease in certain individuals.

2. Why is it important to understand the interrelationships between human genetic diversity, genome function and dietary components?

#### **Unit 4**

1. Describe the different types of genetic variations.
2. Differentiate genotype from phenotype.

#### **Unit 5**

- 1(ai). What is the fate of nutrients in the cell?  
(aii.) Explain the activities of nutrient in the cell.  
(bi) . Describe the cause of familial hypercholesterolaemia.  
(bii). What is hypolactasia?
- 2 a. What do you understand by personalized nutrition?  
b. Explain the term epigenetic.

### **PRESENTATION SCHEDULE**

Your course materials have important dates for the early and timely completion and submission of your TMA, attending tutorials and participating in online class discussion. You should remember that you are required to submit all your assignments by the stipulated time and date. You should guard against falling behind in your work.

### **ASSESSMENT**

There are three aspects to the assessment of the course. First is self-assessment exercise, second consists of the tutor-marked assignment and third is the written examination/end of course examination.

You are advised to do the exercise. In tackling the assignments, you are expected to apply information, knowledge and techniques you gathered during the course. The assignments must be submitted to your facilitator for formal assessment in accordance with the deadlines stated in the presentation schedule and the assignment file. The work you submit to your tutor for assessment will count for 30% of your total course work. At the end of the course you will need to sit for a final or end of course examination of about a two and half hour duration. This examination will count for 70% of your total course work.

## TUTOR-MARKED ASSIGNMENTS (TMAS)

Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you cannot complete your work on time, contact your facilitator before the assignment is due to discuss the possibility of an extension. Extension will not be granted after the due date unless there are exceptional circumstances.

## FINAL EXAMINATION AND GRADING

The end of course examination for Nutrition in Health and Diseases will be for about two and half hours with a weight of 70% of the total course work. The examination will consist of questions, which will reflect the type of self-testing, practice exercise and tutor-marked assignment problems you have previously encountered. All areas of the course will be assessed. Use the time between finishing the last unit and sitting for the examination to revise the whole course. You might find it useful to review your self-test, TMAs and comments on them before the examination. The end of course examination covers information from all parts of the course.

## COURSE MARKING SCHEME

Assignment	Marks
Assignments 1-4	Four TMA, best three marks of the four count at 10% each – 30% of course marks
End of course examination	70% of overall course marks.
Total	100% of course materials.

## OVERVIEW OF THE COURSE

The need for basic knowledge in Nutrition and Health for Health workers irrespective of cadres is indeed undisputed. The Public Health workers are at the primary level of prevention, hence, they need basic understanding of nutrition. Basic knowledge in Nutrition has been ascertained to assist in restoring, maintaining and promoting quality health.

The course intends to equip you with basic knowledge in Nutrition that will permit you not only to improve your health, but also that of your family and the public at large. The whole course is portioned into 5 modules. Module 1, in the text deals with historical perspective of nutrition, Module 2, focuses on the essential nutrients required by the body, Module 3 described food classification, purchasing, preparation and presentation of foodstuffs, Module 4 addresses the various ways of assessing the nutritional status and application of dietary knowledge in caring for common non communicable chronic diseases (hypertension, type two diabetes mellitus). Finally, module five discussed nutritional genomics.

At the end of each unit, assignments are given to assist you assess your understanding of the topics that have been discussed.

### **HOW TO GET THE MOST OUT OF THIS COURSE:**

Implicit interest and regular culture of reading are of utmost requirements for getting the best out of this course. It is paramount that you should at least purchase one of the textbooks that are recommended for you. More importantly, attending tutorials sessions and completing your assignments on time will certainly assist you to get the best out of this course.

### **FACILITATORS/TUTORS AND TUTORIALS**

There are 16 hours of tutorials provided in support of this course. You will be notified of the dates, time and location of these tutorials as well as the name and phone number of your facilitator, as soon as you are allocated a tutorial group. You will also be notified of the dates and time of online discussion class.

Your facilitator will mark and comment on your assignments, keep a close watch on your progress and any difficulties you might face and provide assistance to you during the course. You are expected to mail your Tutor-Marked Assignment to your facilitator before the scheduled date (at least two working days are required). They will be marked by your tutor and returned to you as soon as possible.

Do not delay to contact your facilitator by telephone or e-mail if you need assistance.

The following might be circumstances in which you would find assistance necessary. You would have to contact your facilitator if:

You do not understand any part of the study or the assigned readings.

You have difficulty with the self-tests.  
You have a question or problem with assignments or with the grading of assignments.

You should endeavor to attend the tutorials. This is the only chance to have face to face contact with your course facilitator and to ask questions which are answered instantly. You can raise any problem encountered in the course of your study.

To gain much benefit from course tutorials class prepare a question list before attending them. You will learn a lot from participating actively in discussions.

## **SUMMARY**

Nutrition in Health and Diseases is a course that aims at producing basic concept and understanding of the discipline. It is concerned with improvement of good health at the family as well as at the community levels through adequate food intake. The ultimate goal of Nutrition in Health and Diseases is to restore, maintain and promote optimal health and prevent some of the non communicable chronic diseases (hypertension, stroke, diabetes mellitus, prostate cancer, breast cancer, obesity).

Upon completing this course, you will be equipped with the basic knowledge of food composition, function of the nutrients, the importance of water and fiber in promoting health, the application of food grouping in planning an adequate diet, significance of food preparation and presentation in food choices, principles of preparing complementary feeding, assessment of nutritional status, nutritional care in diseases, the role of religion and culture in promoting positive dietary habits.

In addition, you will be able to answer the following questions: What is nutrition?

- Describe nutrition as an art.
- List 5 notable names in the beginning of the study of nutrition.
- What is the focus of Nutrition Research in the early century till present? What is the relationship between food intake and culture?



- List the major nutrients in the food. Classify food into four categories.
- What is the significance of food preparation in attaining adequate nutrition?
- Define complementary feeding.
- Give two examples of complementary feeding.
- Identify the methods employed for nutritional assessment of a community.
- Define the terms Nutrition Education and Nutrition Information. Describe nutritional care in diseases.
- What are the principles for planning nutrition care for hypertensive and diabetic patients?
- Discuss the concept of nutrigenomics.

Of course, the list of questions that you can answer is not limited to the above list. To gain the most from this course you should endeavor to apply the principles you have learnt to your understanding of Nutrition in Health and Diseases.

I wish you success in the course and I hope that you will find it both interesting and useful not only to you, but to your immediate family and to your community at large.

**MAIN  
COURSE**

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**MODULE 1            NUTRITION AND ITS HISTORICAL  
PERSPECTIVE**

Unit 1	Introduction to Nutrition
Unit 2	Notable names in the Beginning of the study of Nutrition
Unit 3	Focus of Nutrition Research in Early Century Till Present.
Unit 4	Food and Culture

**UNIT 1                INTRODUCTION TO NUTRITION****CONTENTS**

1.0	Introduction
2.0	Objectives
3.0	Main Content
3.1	Definition of Nutrition and other Common Terminologies in Nutrition
3.2	Description of an adequate diet
3.3	The ancestral human nutritional behaviour before agricultural and industrial revolutions
3.4	The effects of agricultural and industrial revolutions on human nutritional behaviour
4.0	Conclusion
5.0	Summary
6.0	Tutor-Marked Assignments
7.0	References/Further Reading

**1.0    INTRODUCTION**

Since you have gone through the course guide, you would have had an overview of what this unit is all about, how it links specifically to the course. This unit intends to expose you to nutrition as a science as well as an art; components of food and common terminologies in nutrition. The unit will round up with Homo sapiens nutritional behavior before and after agricultural and industrial revolutions.

The effects of such revolution on the health of Homo sapiens shall also be examined. Prior to improving your knowledge in nutrition, it is important that we should learn in this unit the objectives as listed below.

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- define nutrition and at least other three relevant nutritional terminologies
- describe nutrition as a science as well as an art
- list at least three examples of an adequate diet
- list at least three differences between the nutritional behaviors of Homo sapiens before and after agricultural revolution.

Now that you have gone through the objectives, let us begin to expatiate on some of the key terminologies used by the experts in the field.

### 3.1 Definition of Nutrition and Other Common Terminologies in Nutrition

Nutrition is defined as the study of food composition and its effects on the body. It can also be defined as an art and science of nourishing the body. Nutrition can be described as a science because it can be proven in animals or human beings. Deficiency of riboflavin (Vitamin B2) for example, leads to angular stomatitis (inflammation of the mouth). Excessive intake of macronutrients: protein, carbohydrate and fats/oil foods can lead to overweight or obesity. Nutrition is also an art because the way the food is presented to the consumer may either be appealing or unappealing regardless of its nutritious values. Food is an edible substance that human being or animals eat or drinks that supply the nutrients that will sustain, maintain and promote life and growth. For example beans, maize, milk, fruit. Nutrients are chemical components of food that supply nourishment to the body. Examples are protein, fats, vitamins, minerals, water and carbohydrates. Micronutrients are the very small molecules that are also part of food composition that are needed in small quantities in the body but very important for good health. Examples of micronutrients are iodine, zinc, iron, vitamin A, selenium and others.

Adequate diet is a diet that contains all the essential nutrients taking in the right proportion at a sitting. An adequate diet can also be referred to as a balanced diet.

In our own community, an adequate diet is one that contains at least one food item from all the food groups e.g. carbohydrate, protein, fats & oil, etc. Malnutrition simply means bad nutrition. Bad nutrition can be classified as under or over nutrition.

Food value refers to the quality and quantity of essential nutrients that each food contains that will promote and rehabilitate good health.

Food security is defined as the availability of food-stuffs in adequate quantity and quality to every member of the household regardless of age, sex, religion, and individual condition.

Nutrition security is the utilization of the food nutrients in the body system in order to restore, maintain and promote quality and healthful life.

### **3.2 Description of an Adequate Diet**

We have seen in unit 3.1, that an adequate diet is essential for optimal freedom from both infectious and non-infectious diseases. An adequate diet does not have to be expensive. Locally available foodstuffs can be easily used to plan an adequate diet. For examples, yam + beans + fats/oil+ leafy green vegetables +crayfish and any fruit in season; Rice + beans+ fats/oil + dark green leafy vegetables + frozen fish + any fruit in season; Boiled plantain + beans + piece of meat + fats/oil + leafy green vegetables + any fruit in season.

### **3.3 The Ancestral Human Nutritional Behavior Before and After Agricultural and Industrial Revolution**

In an attempt to understand the present modern dietary behaviors of Homo sapiens, it is very important to examine our ancestor's diet behaviors,100,000 generations of our people were hunter-gatherers before agricultural revolution. Their main sources of carbohydrates, fats and protein were from fruits, vegetables, nuts and wild animals. Their consumption of fiber was very high due to eating over one hundred different fruits and vegetable.

Their consumption of salt was very low and that of potassium was very high. These two nutrients have been identified as the etiology and prevention of cardiovascular diseases. The consumption of omega-3 fatty acids was higher than omega – 6 fatty acids. These essential fatty acids have been implicated in the etiology and prevention of cancer and cardiovascular diseases. 'Of necessity, the ratio of meat and fruits/vegetables varied with geographical location, climate and season'.

Five hundred generations have depended on agriculture. The invention of digging tools led to introduction of root, tuber and bulbs to their diets. The Homo sapiens were domesticated to produce milk and protein. Large amounts of grains, milk and protein were consumed and they

became more sedentary. Whereas, drinking of milk was rarely done beyond infants.

The Homo-sapiens dietary behaviors have definitely changed our evolutionary diet due to agricultural and industrial revolution. Ten thousand generations have lived since the start of the industrial age. The industrial revolution has led to refining the grains into flour, processing of animal protein, thereby adding additives, salts and fats and oils to preserve the processed foods. The industrial revolution has also led to establishment of plethora of fast food restaurants. The industrial revolution has brought a drastic shift from diets high in fruits and vegetables, lean meat, and sea food to highly processed foods high in sodium and hydrogenated fats and low in dietary fiber.

### **3.4 Effects of Agricultural and Industrial Revolutions on Homo Sapiens' Health**

Over the past 100 years, the dietary behaviour of Homo sapiens have changed tremendously due to agricultural and industrial revolutions. These two revolutions have some adverse effects on human health. These adverse effects include: increased consumption of highly processed and refined grain-based carbohydrates which may lead to increase in type II diabetes mellitus. Increased consumption of refined sugar (sucrose) which was never part of our ancestors' diet. This also could lead to increase in type II diabetes mellitus. The increased usage of pesticides and fertilizers may result to reduced nutritional quality of the foodstuffs. The high increase of domestic animals and refined grains may lead to higher increase of omega 6 than omega-3 fatty acids which may lead to increase in cardiovascular diseases and cancer.

Reduced consumption of fruits and vegetables and excessive consumption of processed refined grains which may lead to constipation and colon cancer.

### **4.0 CONCLUSION**

In this unit you have learnt the importance of nutrition to the achievement of quality health. You have also learnt some common terminologies in nutrition. More importantly, you have also learnt how nutrition is a science as well as an art. The unit has also discussed the Homo sapiens nutritional behaviours before and after agricultural and industrial revolutions. The rapid change of our ancestors' diets to high refined processed grains coated with salt and sugar, very low fruits and vegetable and its consequences on health are also elucidated in the unit.

At this point, you should be able to define nutrition and some common terminologies in nutrition. In fact, you should be able to demonstrate that nutrition is a science and not fad and also give two examples of adequate diets using our locally available foodstuffs. In a nutshell you should be able to describe changes in our ancestors' diet.

## **5.0 SUMMARY**

This unit being an introduction has defined some key definitions in Nutrition and brought out the importance of nutrition in the maintenance, restoration, and promotion of quality health. The unit has also illustrated nutritional historical perspective of homo sapiens, in terms of drastic changes in nutritional behavior before and after agricultural and industrial revolutions over the past 100 years. Unit two will further give insight to other historical aspects of nutrition.

## **6.0 TUTOR-MARKED ASSIGNMENT**

1. In your own words define the terms nutrition, food and micronutrients.
2. Enumerate the main differences between our ancestors' diet and the modern ones.

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## **UNIT 2 NOTABLE NAMES IN THE BEGINNING OF THE STUDY OF NUTRITION**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main subject
  - 3.1 Important names in the study of Nutrition
  - 3.2 Major contribution of each person
  - 3.3 The importance of these contributions to human nutrition
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked assignments
- 7.0 References/Further Reading

### **1.0 INTRODUCTION**

Since you have gone through unit 1, you would have had an overview of what nutrition is all about in attaining quality health from the womb to old age. This unit will help you to acquire basic understanding of man's endeavors to investigate the mysteries of nourishing the body from the ancient times, those men and women who were the pioneers? and the importance of their contributions to human nutrition.

### **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- list at least five notable names in the beginning of the study of nutrition
- identify the major contribution of at least three of the notable names listed above
- describe the importance of at least two contributors to present nutrition study.

### **3.0 MAIN CONTENT**

#### **3.1 Notable Names in the Study of Nutrition**

It is important that you should know that men and women that started the study of nutrition were physicians (medical doctors), engineers, biologists, philosophers, artists, physiologists, chemists and scientists. You will be exposed to prominent contributors. The list is large, you are just going to be given some of the names.

The names include Atwater, D.D., Black J; Bernard, C, Boyle; Davidson and Passmore; Goldberg, Hippocrates, Hopkins, F.C., Lavoisier, A.L., Liebig, B.J., Lind, Magendle, F; Mayo, J, McCarrison, R; Mulder , G,J., Ohlson, M, Orr, J.B., Priestly, J., Proat, W; Reaumar, Sallanzani, Sanctorius, Sherman, H.C., Tokaki, Leonardo da Vinci; and Vot, C.

### 3.2 Major Contributions of Notable Men and Women

- \* Atwater, W.D – Prepared the first food composition tables.
- \* Bernard, C., discovered glycogen (animal starch) and also proclaimed the pancreatic juice that is necessary for the absorption of fats.
- \* Davidson and Passmore identified thiamine to be responsible for beri- beri. Goldberg associated pellagra disease with population subsisting mainly on corn.
- \* Hippocrates known as the ‘father of medicine’ was the first to show that children consumed more food than adults. He also prophesied that ‘those that are naturally very fat are apt to die earlier than those who are slender’.
- \* Hopkins, F.C. identified certain food substances that when absent could lead to certain diseases such as rickets and scurvy.
- \* Lavoisier, AL - known as ‘father of nutrition demonstrated that the food that was eaten was like a fuel in the body and that the more a man worked, the more food needed.
- \* Liebig B.J – taught that fats and carbohydrates were fuel foods and later called nutrients that formed body tissue during growth.
- \* Liud was the first to conduct controlled clinical trials on the reason for fresh fruits and vegetables would cure scurvy.
- \* Magendle F. – demonstrated that food containing nitrogen was essential to life.
- \* Mayow proved that when air was breathed in it was taken up by blood and transported to the part of the body.
- \* McCarrison R. reported that the well being and stature of people were attributed to their diets.
- \* Mulder GJ – identified the nitrogen content in food to be protein meaning ‘to take first place’.
- \* Ohlson, M. – Reported study on western women aged 30 to 70 years showing that those who drank more milk and ate more eggs, vegetables and whole grain cereals and bread were in good health than those who had chronic diseases.
- \* Orr, JB – reported similar study when studying various tribes in Africa - He noted that greater vigour and stature were

associated with a diet that contained meat and milk in contrast to diet mainly on cereals and other plant food sources.

- \* Prestley J – Conducted studies that discovered the gas called oxygen.
- \* Prout W. – He was the first to classify food into three groups, foods of animal origin, foods of a vegetable origin and a group of fatty or oily foods.
- \* Reaumar, R. – Demonstrated that stomach did not grind food, but rather it produced chemical that affect the food.
- \* Spallanzani – Investigated digestion of food in the stomach and the function of the gastric juice.
- \* Sanctorius – experimented with himself to detect all that happened to food consumed by weighing everything he ate, drank and also everything that came out of him.
- \* Sherman - He provided quantitative knowledge of nutritional requirements for man.
- \* Takaki - He proposed addition of milk and vegetables to wipe off beri- beri among the sailors.
- \* Vinci, Le – Made statements about nutrition that had a modern connotation.
- \* Voit C – He was the first person to work on nitrogen balance studies using dogs as experimental animals. He demonstrated the use of protein to build and maintain tissue.

### **3.4 The Importance of these Contributions to Human Nutrition**

These great men and women laid the foundation for the modern human nutrition. Identifications of essential nutrients in food and their usefulness to support and maintain life actually laid the foundation for further investigation as to nutrient deficiencies and infectious diseases. The modern human nutrition experts have applied the works of these notable men and women to examine the connection between diets and noncommunicable diseases such as type II diabetes mellitus, cancer, cardiovascular disease obesity, and other diseases.

### **4.0 CONCLUSION**

In this unit you have been introduced to notable names in the field of nutrition. You have also noticed that the majority of these men and women were physicians, biologists, physiologists, chemists or philosophers. The unit has also expatiated the contributors of these notable personalities to the field of nutrition. Their major contributions included identification of chemicals in the air and nutrient deficiencies in human being.

All this point you should be able to identify the professionals of the early researchers in the field of nutrition. You should be able to list at least ten notable names in the study of nutrition at the beginning. You should also be able to link the contributions of these distinguished personalities to the present study of nutrition.

## **5.0 SUMMARY**

This unit being a follow up of unit 1, has highlighted the notable names in the beginning of the study of nutrition. The unit has identified the key contributions of these notable men and women. The unit has also discussed the significance of these contributions to modern study of nutrition.

## **6.0 TUTOR-MARKED ASSIGNMENT**

1. List 4 notable names in study of nutrition and their contributions.
2. What are the linkages between the early pioneers of nutrition to the present dietary behaviour?

## **7.0 REFERENCES/FURTHER READING**

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## **UNIT 3      FOCUS OF NUTRITION RESEARCH IN EARLY CENTURY TILL PRESENT**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Content
  - 3.1 Focus of Nutrition Research in Early Century.
  - 3.2 Focus of Nutrition Research in the first half of 20th Century.
  - 3.3 Focus of Nutrition Research in the 20th Century till present.
  - 3.4 The usefulness of Nutrition Research.
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Reading

### **1.0 INTRODUCTION**

Since you have gone through unit 2, you would have acquired general knowledge of notable names in nutrition and their contributions. This unit will help you to acquire basic knowledge as to the trend of research endeavors in human nutrition from the early century till present.

### **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- Identify at least two major foci of research works in nutrition in the early century.
- Describe the primary focus of nutrition research in the first half of 20th Century.
- List at least three major nutrient deficiencies chronic diseases being research foci in the 20th Century till date.

### **3.0 MAIN CONTENT**

#### **3.1 Focus of Nutrition Research in Early Century**

The early pioneers in nutrition as illustrated in Unit 2, focused on chemical investigation in the air, studies on respiration, the importance of food as fuel to children and adults' good health, classification of

foods, identification of protein in foods and discovery of glycogen (animal starch).

### **3.2 Focus of Nutrition Research in the First Half of 20th Century**

This era witnessed researches in human nutrition that focused on the role of essential nutrients, especially vitamins in human deficiency diseases. It was after the Second World War that research in nutrition in industrial countries began to focus on the role of diet in non communicable diseases such as diabetes mellitus, cancer and cardiovascular diseases. The century has witnessed a plethora of information on diet and its implication with non communicable diseases but such information is devoid of guidance on methods of differentiating facts from fallacy.

### **3.3 Focus of Nutrition Research in 20th Century Till Date**

This century has witnessed a significant shift in the direction of nutrition research from nutrient deficiency diseases as the major causes of morbidity and mortality to investigating the role of diet in the maintenance of health and reduction of the risk of non communicable diseases (NCCDs). Presently, the research challenges of identifying dietary factors that predispose man to specific NCCD and to explain such connection of the diseases dietary habits? In fact, researches on the effects of supplementary antioxidants (vitamin A, C, and D, Selenium) and other phyto chemicals in the management and prevention of non-communicable diseases, such as cancer, cardiovascular diseases and type II diabetes mellitus are the current focus of nutrition research.

### **3.4 The Usefulness of Nutrition Research**

It is important to understand the usefulness of research in nutrition for the following reasons:

- It helps to understand the important nutrients in food that prevent deficiencies.
- It assists to pinpoint the major nutrients that may be involved in the aetiology of obesity, cancer and cardiovascular diseases.
- It provides guidelines aimed at reducing the risk of one or more non-communicable diseases (NCCDs).
- It gives an insight as to the role of diet in NCCDs.
- It helps to develop step by step evaluation of scientific evidence relating to dietary composition of foods, food groups and dietary patterns to maintenance of health.

- It helps to investigate the role of diet in the maintenance of health and the reduction of the risk of NCCDs.
- It helps to identify dietary factors that influence specific diseases and explains the mechanisms.

#### **4.0 CONCLUSION**

In this unit, you have been exposed to the foci of nutritional research endeavours from the early century till present. Researches in human nutrition in the early century focused on chemical identifications of nutrients in food. The role of essential nutrients, especially, vitamins, in human deficiency diseases was the focus of the half of the twentieth century. The nutrition research endeavours continued after the World War II with the role of diet in the aetiology of NCCDs. Presently, researches in nutrition involves the role of antioxidants and other phyto chemicals in the prevention of NCCDs. The search on functional foods to promote healthy life span is still on in most developed countries.

#### **5.0 SUMMARY**

This unit being a continuation of Unit 2, has expatiated on the foci of nutrition research from early century till present. The unit has illustrated that research studies in nutrition has shifted emphasis from nutrient deficiency diseases as the major causes of morbidity and mortality to non communicable chronic diseases. In fact, the focus now is the role of diets in the aetiology of NCCDs. This unit has also discussed the usefulness of nutrition research in the promotion of life free from NCCDs. The next unit, you will be exposed to food, the vehicle of diet.

#### **6.0 TUTOR-MARKED ASSIGNMENT**

1. Differentiate between nutrition research endeavours in the first half of 20th and 21st centuries.
2. Discuss three importance of nutrition research.

#### **7.0 REFERENCES/FURTHER READINGS**

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## **UNIT 4      FOOD AND CULTURE**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Subject
  - 3.1 Food and Culture
  - 3.2 Definition of terminologies in culture
  - 3.3 The meaning of food
  - 3.4 The functions of food
  - 3.5 Cultural and Religious food choices
  - 3.6 Factors influencing food habits
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Reading

### **1.0 INTRODUCTION**

Since you have gone through units one to three, you would have acquired a general understanding of what nutrition is all about, it's historical background together with notable names in the field and research endeavours past and present.

This unit will help you acquire basic understanding of how food and culture affect the diet of an individual or a group.

### **2.0 OBJECTIVES**

At the end of this unit, you should be able to;

- define the terms food, food habits, food taboos, staple food and culture
- describe the meaning of food
- list at least four functions of food
- enumerate the effects of cultural and religious food taboos on the nutritional status of an individual
- list at least five factors that influence food choices.

### **3.0 MAIN CONTENT**

#### **3.1 Definition of Terminologies in Food and Culture**

- \* Food is an edible digestible, absorbable and utilizable substance that maintains, restores and promote growth and quality health. It can also be defined as an edible substance that human being

or animals eat or drink that supply the nutrients that will sustain, maintain and promote life and growth.

- \* Food habits also referred to as food culture is defined as the ways in which human beings use food that includes selection, touch, smell and presentation.
- \* Staple food can be defined as basic food which is the main regular constituent of a meal of a group of people, a tribe, a region or a community. Maize, green plantain, cassava or other tubers are staple foods of certain parts of Africa. Rice and potatoes are the staple foods for India and Ireland respectively. Bread is the staple foods for Europe and Hamburger and French fries staple foods for United States. Nigeria staple foods are starchy foods (cassava meals, pounded yam), yam flour grains (millet, maize in the form of pap).
- \* Culture, Kittler and Sucher defined culture as the 'values, beliefs, attitudes, and practices accepted by members of a group or community. Culture can be learnt, it is not inherited, it is passed from generation to generation.

### 3.2 The Meaning of Food

Food means different thing to each person depending on the time, place, health, economic and social status.

A food may arouse the feelings of pleasure, prosperity, happiness, sadness, masculinity, femininity, poverty, power or comfort. The culture in which a person lives, the family in which he or she grows up and experiences of travelling widely actually determine all that food means to an individual. Food is the vehicle by which one nourishes the body. When staple foods are mainly from plant sources and the culture is not very flexible about adopting newer nutritious food such as soybeans, the nutritional status of such people will be poor.

### 3.3 The Functions of food

- \* The primary function of food is to supply energy to the body. The first body requirement is to have enough energy before performing other functions. The energy nutrients include carbohydrates, fats and proteins. The food source of energy is carbohydrate, fats and oils.
- \* Food nutrients also build and maintain body tissues. The body building material in foods is protein.
- \* Food nutrients also regulate body processes. The minerals, the vitamins and water each of these nutrients present in the food you

consume perform certain regulatory functions that are crucial to the normal operation of the body system. Such regulations include the movement of fluids, the coagulation of blood, maintenance of normal body temperature and control of the balance between acid and base.

- \* Food serves as a socializing agent or as means of friendship. It also serves as means of developing social rapport.
- \* Food is also a way of satisfying certain emotional needs.
- \* Food is also used as a means of expressing feelings. The serving of favorite foods and its withdrawal is an expression of appreciation and punishment respectively.

### **3.4 Cultural and Religious Food habits**

Cultural and religious food habits are dictated by the culture or the religion of the group. One of the major causes of childhood malnutrition in some developing countries is cultural food taboos to infants and also to pregnant women. Certain foods are forbidden to pregnant women and infants either due to religion or tradition. Snails and snakes for examples are forbidden to infants and pregnant women because such foods will make the infants unable to walk or crawling excessively. Some religion prohibits certain foods, especially of animal origin, such as pork, bats, and certain fish.

### **3.5 Factors Influencing Food Choices**

- \* Family influence especially that of the care giver (the mother).

Whatever a mother likes she gives to the family and the children gradually learn through observation.

- \* Mother's nutritional knowledge also influences food habits. The knowledge of adequate nutrition intake on regular basis will certainly help to nurture the family to eat healthfully.
- \* Advertising is one of the major instruments used by food industries to appeal to consumers to buy their food products.
- \* Religion also influences food habits. The Christians and Muslims when fasting have certain food habits which everybody in the family accepts.
- \* Flavour and texture are two of the most significant factors for choosing certain foods.
- \* Peer influences affect food choices especially among the young ones.

- \* Current health status is also a factor in food choices. A healthy person has a good appetite while the contrary is the case for an ill person.
- \* Social changes are also leading factors for food choices. The higher the social status, the more exposure to convenience foods or fast food outlets.

## **5.0 CONCLUSION**

In this unit you have learnt what food and culture are all about. In defining food and culture, you have noted that food is the vehicle for nourishing the body to perform maximally. You have also been exposed to the importance of staple foods in improving the health of an individual. You should be able to define food, staple foods and give specific example, for a particular tribe in Nigeria. The unit has illustrated the different meaning of food to different people. It has highlighted different functions of food. The importance of culture and religion in the selection of food has also been discussed. You should be able to list those foods being prohibited because of culture and religion in your locality. Finally, the unit has discussed factors influencing food choices. You should be able to list those factors influencing your own choice of foods.

## **5.0 SUMMARY**

This unit has examined food and culture in the selection of foods for healthy living. It has also defined key terminologies under the topic. Meaning of food and its functions in promoting quality health have been elucidated in the unit. Factors influencing food choices are also shown to be important in maintaining nutritional status. The second module will be built on basic understanding of composition of food (carbohydrates, proteins, fats, vitamins, minerals, water and fiber).

## **6.0 TUTOR-MARKED ASSIGNMENTS**

1. Using appropriate examples, define the terms staple food and food habits.
2. List four factors that could influence food choices.

## **7.0 REFERENCES/FURTHER READING**

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**MODULE 2            BASIC KNOWLEDGE IN NUTRITION**

Unit1	Carbohydrates
Unit 2	Proteins
Unit 3	Lipids (Fats and Oils)
Unit 4	Minerals and Vitamins
Unit 5	Water and Fiber

**UNIT 1            CARBOHYDRATES**

1.0	Introduction
2.0	Objectives
3.0	Main Content
3.1	Types of carbohydrates
3.2	Functions of carbohydrates
3.3	Digestion of carbohydrates
3.4	Recommended Allowances for carbohydrates
3.5	Food sources of carbohydrates
4.0	Conclusion
5.0	Summary
6.0	Tutor-Marked Assignment
7.0	References/Further Reading

**1.0    INTRODUCTION**

Since you have gone through the historic background of nutrition and the ancestral nutritional behaviors before and after agricultural and industrial revolutions, you will be exposed to basic knowledge of food composition. Carbohydrate is one of the essential nutrients in food. This unit will expose you to the importance of carbohydrates, its classifications, functions and food sources.

**2.0    OBJECTIVES**

- by the end of this unit, you will be able to:
- identify two types of carbohydrates
- describe simple carbohydrate
- list at least three functions of carbohydrates
- identify the end product of carbohydrates
- list four sources of carbohydrates.

### **3.0 MAIN CONTENT**

#### **3.1 Types of Carbohydrates**

There are two types of carbohydrates. They are simple and complex carbohydrates. Simple carbohydrates are easily digestible by humans and animals. Examples of simple carbohydrates are monosaccharides and disaccharides. The most important monosaccharide is glucose. Glucose is needed every second by the brain. The disaccharides are two molecules of sugar, such as sucrose, maltose and lactose. Sucrose is broken down to fructose and glucose, while maltose is broken down to two molecules of glucose. Lactose is popularly referred to as milk sugar. Upon digestion it yields glucose and galactose. Galactose, fructose and glucose are examples of monosaccharides. Complex carbohydrates are polysaccharides that contain as many as 2000 simple carbohydrate units in long chains. Starch, glycogen, and cellulose are examples of complex carbohydrates. Starch is found in seeds, and grains and tubers. Glycogen is a form of glucose storage in animals.

#### **3.2 Functions of Carbohydrates**

- \* It supplies energy which serves as body fuel to both internal and external activities.
- \* It spares protein from being used as a source of energy. One gram of carbohydrate will supply 4 kilocalories to the body.
- \* It supplies glucose to the body especially the brain
- \* It helps the body to burn body fat.
- \* It adds flavour to our diet.
- \* It helps in the formation of genetic materials (Deoxyribonucleic acid

DNA and Ribonucleic acid RNA).

#### **3.3 Digestion of Carbohydrates**

Digestion of carbohydrates begins in the mouth and ends in the small intestine. In the mouth, the food is chewed and broken down into small pieces and mixed with saliva which contains salivary amylase ptyalin. This enzyme splits disaccharides such as maltose. The digestion continues in the duodenum (the first part of the small

intestine) that contains pancreatic amylase which continues to break down other disaccharides into the final end product which is glucose. The other enzymes in the intestine are maltase, sucrase and lactase.

Maltase breaks down maltose into two molecules of glucose. Lactase breaks down lactose into one molecule each of glucose and galactose and sucrase converts sucrose into one molecule each of glucose and fructose. Remember that the end product of carbohydrate is glucose.

### **3.4 Recommended Allowances for Carbohydrate**

Since carbohydrate is universally available, there is no basis for the formulation dietary allowance for carbohydrate. However, it should be noted that carbohydrate and fats are suppliers of energy. Energy requirement is increased during pregnancy, lactation and infancy.

### **3.5 Food Sources of Carbohydrates**

The major carbohydrates are found in sugars, cereal grains (corn, millet, wheat, rice, guinea corn, acha), legumes (beans, soya beans, groundnut, and dried fruits, tubers and vegetable).

## **4.0 CONCLUSION**

In this unit, you have learnt about carbohydrate as an important nutrient needed for the body especially, the brain. You have also been exposed to the types of carbohydrates and examples of each type. The breaking down of carbohydrates has

also been taught in this unit. You have also known some of the vital functions and sources of carbohydrates.

Remember that everything you eat contains carbohydrate and its digestion begins in the mouth and continues in the small intestines with specific enzymes. The end product of carbohydrate is glucose.

## **5.0 SUMMARY**

This unit has introduced you to one of the nutrients that is found in the food you eat. It has exposed you to two types of carbohydrates, their functions and digestion in the body. You have also learnt about the food sources of this important nutrient.

## **6.0 TUTOR-MARKED ASSIGNMENT**

1. List five functions of carbohydrates.
2. Discuss, the journey of a piece of bread you have just taken in terms of its digestion.



## **7.0 REFERENCES/FURTHER READINGS**

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## UNIT 2     **PROTEIN**

### CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Content
  - 3.1 Classification of protein
  - 3.2 Functions of protein
  - 3.3 Digestion of protein
  - 3.4 Recommended Allowance for protein
  - 3.5 Protein Deficiency Diseases
  - 3.6 Supplementary and complementary protein
  - 3.7 Food sources of protein
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Readings

### 1.0 INTRODUCTION

Since you have gone through the types and functions of carbohydrates in unit, you would have acquired general view that carbohydrate spares protein. This unit will help you to appreciate the importance of protein as a body builder and repairer.

### 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- identify the chemical elements in protein
- classify protein into three groups
- differentiate between animal and plant protein
- identify the difference between supplementary and complementary protein
- list at least two functions of protein
- identify the end product of protein
- list at least 3 food sources of protein that are cheap but of high value.

### 3.0 MAIN CONTENT

#### 3.1 Classification of Protein

The word “protein’ simply means, to come first. This nutrient is the most indispensable nutrient that supplies essential and non-essential amino acids. These essential amino acids are necessary for body building and tissue repairments.

Protein can be simply grouped under two broad headings. The animal and plant protein sources. Animal protein sources are usually referred to as complete protein because it contains all the essential amino acids (Isoleucine, Leucine, Lysine, methionine, phenylalanine, threonine, tryptophan, and valine). These eight essential amino acids are for adults. For infants, histidine is listed as 9th amino acid essential for them. Proteins are majorly classified according to their solubility and other physical properties. Three classes are used to categorise protein;

**Simple proteins:** These are protein substances that yield amino acids after complete hydrolysis. Albumen of egg, keratin of hair and goblin of hemoglobin are examples of simple proteins.

**Conjugal proteins:** These are protein compounds with some other non protein molecules or molecules with metal upon hydrolysis. Examples are haemoglobin (protein + heme) of blood, casein (protein + phosphoric acid of milk and lipoprotein (protein + lipid) in blood plasma.

**Derived proteins:-** These are products formed from the partial breakdown of proteins by the action of heat and other physical forces or by hydrolytic agents, peptones, polypeptides, and peptides (mixtures of amino acids with decreasing numbers of amino acids in the chains length).

#### 3.2 Functions of Protein

The chief functions of protein are to:

- Provide amino acids for the body to build new tissues, and normal growth of infants.
- Help to maintain body tissue and replacement of damaged or worn out tissues in both adults and children.
- Help in the formation of hormones, enzymes and antibodies. Serve as source of energy in the absence of carbohydrate.

### 3.3 Digestion of Protein

Protein digestion starts from the stomach. The long chains of proteins are split into smaller units by an inactive enzyme pepsinogen that is converted to pepsin upon being in contact with hydrochloric acid.

The main protein connective tissue, called collagen is digested by pepsin. The vast majority of protein digestion occurs in the duodenum. The liquefied mass of food called chyme passes through the pyloric sphincter into small intestine where the activation of enterokinase, an enzyme that activates pancreatic trypsinogen into trypsin. Trypsin, chymotrypsin and carboxypolypeptidase breakdown the links of polypeptide chains and further subdivide them into small polypeptides. These result in free amino acids.

### 3.4 Recommended Allowance for Protein

For adult men and women 18 to 35 years of age, the recommended daily dietary allowance is one gram per kilogram of body weight. It is also recommended that the dietary allowance for infants should be increased as they grow up, while adult men and women should decrease their allowances as they add years. The protein requirements for babies are based on complex calculations of total intake and N (Nitrogen) content of breast milk fed directly or by bottle to babies in the first 4-6 months of life. Yet 20% of the total N in breast milk is in the form of non-amino acid N such as urea. Because babies grow well on this milk, provided they have enough, the total N is assumed to be utilized and figures are calculated as though the N were all protein. From 6-12 months, the breastfed child is still growing rapidly but now has to rely on other sources of food, i.e. supplementary feeds. Extra protein needs are needed by pregnant women, lactating mothers, early adolescents, individuals under stress and post-surgery patients.

### 3.5 Protein Deficiency Diseases

A deficiency disease of protein is called protein energy malnutrition (PEM). It was formerly known as Protein Caloric malnutrition (PCM). The term energy refers to both calorie and fats. The patterns of PEM are, kwashiorkor, marasmus, marasmic – kwashiorkor and under nutrition. Other form of protein deficiency in humans includes nutritional liver disease. This deficiency is commonly observed in alcoholic patient and kwashiorkor children. The disease is characterized by an enlarged fatty liver and oedema.

### **3.6 Supplementary and Complementary Protein**

All animal proteins are first class protein because they contain all the essential amino acids. Plant proteins on the other hand are regarded as second class protein because they lack one or two essential amino acids. When you add an animal protein to a protein from plant source, such a combination is regarded as supplementary protein. For example, maize + meat, groundnut + crayfish etc. It is the animal protein that is supplying all the essential amino acids.

Complementary proteins are the combinations of two important plant protein sources. Example are Beans and rice, maize and groundnut. Grains are deficient in lysine and legumes are deficient in methionine. Rice, millet, maize and wheat are grains while beans, and groundnut are legumes.

### **3.7 Food Sources of Protein**

The food sources of animal proteins include fish, crayfish, eggs, milk, goat meat, pork, chicken, turkey, crab, breast milk etc. The major plant protein sources are cowpea seeds, soybeans, groundnuts, locust beans, pinto beans, red kidney beans and lima beans. Grains such as rice, wheat, maize, guinea corn, acha, millet are also fair sources of protein.

## **4.0 CONCLUSION**

In this unit you have learnt that protein is an essential nutrient that makes up the building block of other body. More importantly, you have been introduced to classes of protein, its digestion, functions and food sources. You should be able to make up a complementary protein diet after you have been exposed to protein food sources.

This unit has also provided you information on the need for higher protein allowances for pregnant and lactating women, infants and early adolescents.

## **5.0 SUMMARY**

This unit being a part of basic knowledge in nutrition has exposed you to the importance of protein in the growth and maintenance of body tissue. It has listed the function of proteins and the uniqueness of amino acids in the formulation of complementary and supplementary protein.

## 6.0 TUTOR-MARKED ASSIGNMENTS

1. (a). Differentiate between classes of proteins.  
(b). List the essential amino acids for children and adults.
2. Briefly describe the differences between supplementary and complementary proteins with specific examples.

## 7.0 REFERENCES/FURTHER READINGS

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## **UNIT 3      LIPIDS (FATS AND OILS)**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Content
  - 3.1 Types of Lipids
  - 3.2 The Essential Fatty acids
  - 3.3 Functions of fats
  - 3.4 Digestion of fats
  - 3.5 Food sources of fats
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Readings

### **1.0 INTRODUCTION**

Since you have gone through the first two units and you have general overview of the importance of carbohydrates and proteins in human health in this unit, you will also learn the importance of fat as an essential nutrient for good health of all ages.

### **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- define lipid.
- differentiate between fats and oils.
- list at least two essential fatty acids
- list at least four functions of fats.
- identify the end product of fats
- list the food sources of fats.

### **3.0 MAIN CONTENT**

#### **3.1 Types of Lipids**

The term lipid is descriptive rather than a chemical name such as carbohydrates or protein. The term refers to fats or fat like substances. Lipids are classified into two groups, simple and compound lipids. Simple lipids are the esters of fatty acids and alcohol. Examples of ester of fatty acids include animal and vegetable fats.

Compound lipids are esters of fatty acids containing groups in addition to an alcohol and a fatty acid. Examples of these lipids include phospholipids such as Lecithin found in egg yolk and milk sterol, such as cholesterol. Generally, lipids are fats and oils. There is a difference between fats and oils. Fats are solid at room temperature, whereas, oils are liquid. Fats and oils are greasy or oily to the touch and they are commonly found in plants and animals. The amount of energy in fats and oils doubles that of protein and carbohydrate. One gram of carbohydrates and protein will yield 4 kcal, each but fats will yield 9kcal.

### **3.2 The Essential Fatty Acids**

Fatty acids can be described as the building blocks of lipids (fats and oils). Like proteins and carbohydrates, they are made up of hydrogen carbon (CH) but they differ by having a carboxyl group (COOH) at the end. Animal fats contain more of saturated fatty acids. This is one of the reasons for animal fats to be solid at room temperature. These fatty acids are long chains with all the carbon chains fully filled with hydrogen ions.

The oils are liquid at room temperature because they contain unsaturated fatty acids. This means some of the carbons are not filled. Some of these unsaturated fatty acids are essential to humans because the body system cannot provide them enough to meet body requirements. Some of these essential fatty acids are linolenic and linoleic.

### **3.3 Functions of Fats**

One of the chief functions of fats is to supply energy.

Fat helps the body to transport fat soluble vitamins (A, D, E and K).

Fat helps in protecting the internal organs of the body by serving as cushion pad, for example the kidney.

Oils provides the essential fatty acids which help in preventing excessive loss of water.

Fat gives taste and feeling of satisfaction in a meal. Without fats food will be too dry to eat.

Dietary fat stored as adipose tissue in man helps man to survive without food for some weeks.

Fat is used by food manufacturers for smoothness and tenderness.



### **3.4 Digestion of Fats**

The digestion of fats begin in the small intestine. The fats are split by the bile and the pancreatic lipase. The bile is secreted by the liver. It is the bile fluid, the bile salts serves as emulsifying agent. These bile salts also accelerate the pancreatic lipase (enzyme that breaks fats) and it also neutralizes the acidity of the chyme. The end products of fats are fatty acids, glycerol and glycerides.

### **3.5 Food Sources of Fats and Oils**

Rich sources of oils are available in plants, such as corn oil, groundnut oil, melon oil, soybean oil and palm oil. Palm oil contains a lot of palmitic acid which is made up of saturated fatty acids. Rich sources of fats are mainly from animal food sources such as pork, meat, whole milk and cheese.

### **4.0 CONCLUSION**

In this unit, you have learnt that lipids are oils and fats and they can be classified into two groups, simple and complex lipids. You have also been exposed to those fatty acids that are essential to human health. You now know that the main difference between oils and fats is their fatty acid composition whether saturated or unsaturated ones. Functions of fats have also been expatiated in this unit. It is hoped that by now, you should be able to examine your fat choices. Are they mostly from plant or animal food sources?

### **5.0 SUMMARY**

This unit has provided you the meaning of lipids, their classification, and composition, digestion, functions and food sources. It has also explained the importance of essential fatty acids.

### **6.0 TUTOR-MARKED ASSIGNMENT**

1. List five functions of fats.
- 2 (a). Why is fat solid at room temperature?  
(b).Give at least two examples each of fats and oils.

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## UNIT 4 MINERALS AND VITAMINS

### CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Content
  - 3.1 Classification of minerals
  - 3.2 Functions of Minerals
  - 3.3 Deficiencies, Requirements and food sources of Minerals
  - 3.4 Definition of Vitamins
  - 3.5 Classification of Vitamins
  - 3.6 Functions, Deficiencies, Requirements and food sources of vitamins
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Reading

### 1.0 INTRODUCTION

Since you have gone through Units 1 to 3, you have learnt that carbohydrates, proteins and lipids are organic compounds made up of chemical elements such as carbon, hydrogen, nitrogen and oxygen. All these organic compounds with water make up about 96 percent of your body weight and the remaining 4 percent is made up of the minerals. In this unit, you will learn about classification of minerals, their functions, deficiencies and food sources. You will also learn about vitamins, they are essential for normal metabolism, growth and development of the body. This unit will explain vitamin functions, classifications, deficiencies, and food sources.

### 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- classify minerals into two major groups
- list at least five of the major minerals
- identify the micro minerals
- describe the difference between major and trace minerals
- list at least five functions of minerals
- identify at least two mineral deficiencies
- list at least three macro and micro minerals each and their food sources
- define and classify vitamins
- differentiate between vitamins and other large molecules

- describe at least three functions of the water soluble vitamins
- describe at least two functions of fat soluble vitamins
- list at least three deficiencies of water and fat soluble vitamins
- list at least three food sources each of water and fat soluble vitamins.

### **3.1 Classification of minerals**

Generally, minerals are inorganic elements which are essential for the correct functioning of the body. The body contains approximately 4% minerals which must be supplied by the diet. They are essential for growth. Minerals do not provide energy by themselves but because they form part of the tissue and skeleton they are essential for growth. Some act as catalyst or carriers, some minerals are constituents of essential molecules such as thyroxine and haemoglobin or act as an integral part of various metalloenzyme such as alkaline phosphate and carbolic-anhydrase. Minerals exist as inorganic ions i.e. they do not contain carbon. They enter the body as ion e.g. calcium enter the body as an ion with two positive charges ( $\text{Ca}^{2+}$ ). It may be combined with a number of negative ions like those from phosphate to form salt. Minerals cannot be changed during digestion. Once they are in the body, they are there until they are excreted. Minerals can be classified into two classes, macro and micro minerals. The macro minerals are those that the body needs in larger amounts more than 5 grams (a teaspoon). These macro or major minerals include calcium, phosphorous, potassium, sulfur, sodium, chloride and magnesium. Calcium and phosphorous are the two major minerals needed by the body in the highest quantities. Micro minerals or trace minerals are those that the body needs in minute quantities less than 5 grams. These micro minerals are iron, zinc, copper, manganese, iodine, selenium. There are other nine trace minerals. These are cobalt, molybdenum, chromium, tin, vanadium, fluorine, silicon, nickel, and arsenic.

### **3.2 Functions of Minerals**

Majorly, minerals function in two important roles as building and regulatory substances. Specifically, the functions of minerals are:

They are building parts in the hard tissues of the body (bones and teeth). They give rigidity to bones, teeth and the whole body. They are part of soft tissues (muscle, protein and nervous tissues are made up of sulfur and phosphorous).

They are components of essential hormones that contribute to healthy body system. For example, iodine is present in thyroxine and zinc is in insulin.

They contribute to the body fluids and tissues as electrolytes concerned with the maintenance of osmotic pressure, and acid-base balance. They also contribute to membrane permeability and muscle irritability and oxygen transport (sodium, potassium, chloride, phosphorous, calcium, magnesium and iron).

- They are essential for blood clot formation.
- They are catalysts in enzymes and hormone system.
- They make possible normal rhythm in the heart beat.

### 3.3 Adult Mineral Requirements, Main Function, Deficiency And Main Sources

This unit will be presented in the form of a table. The main function, deficiency and sources of each mineral will be indicated.

The macro minerals will be shown in Table 1 and the micro minerals will be in Table 1.

**Table 1: Adult Mineral Requirements, Functions, Deficiency and Main Sources**

Macro mineral	Chief Functions	Deficiency Symptoms	Adult minimum requirement	Chief food sources
Chloride	Part of hydrochloric acid, maintains normal fluid and electrolyte balance.	None	750mg/day	Table salt, moderate amounts in all foods.
Potassium	Assists in nerve impulse transmission muscle contraction, and maintains normal fluid and electrolyte balance	Muscular weakness, paralysis, confusion	2000mg/day	All whole foods, milk, fruits, grains and legumes
Calcium	The principal mineral of bones and teeth involves in muscle contraction	Stunted growth in children, bone loss.	1000mg/day (19-50years) 1200	Milk, snail, fish with bones, greens and

	and relaxation blood clotting, blood pressure and immune defenses	(Osteoporosis)	mg/day(51 and above)	Legumes
Phosphorus	Helps in the contraction of nerves and muscles. It helps in the synthesis of protein, functioning of immune system and also enzyme activator.	Weakness, confusion, if extreme, convulsion, hallucination, difficulty in swallowing in children & growth failure	420 mg/day (men 31 years +, 320 mg/day women 31yrs+)	Nuts, legumes, whole grains
Magnesium	Helps in the contraction of nerves and muscles. It helps in the synthesis of protein, functioning of immune system and also enzyme activator.	Weakness, confusion, if extreme, convulsion, hallucination difficulty in swallowing in children, growth failure.	420mg/day men 31yr+ 320mg/day women 31+	Nuts, legumes whole grains.
Sodium	It improves the taste of foods, aids in transmitting electrical impulses in the body system maintains normal fluid and electrolyte balance.	Muscle cramps mental apathy loss of appetite	500mg/day	Table salt, in all foods.

Sulfur	It helps in the oxidation-reduction reactions, it is part of proteins, vitamin biotin and thiamine and the hormone insulin.	None	-	All protein food sources.
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**Table 2: Adult Mineral Requirements, Function, Deficiency and Main Food Sources**

Micro mineral	Chief functions	Deficiency symptoms	Adult minimum	Chief food sources
Iron	Helps in the building of red blood cells, part of the hemoglobin, and myoglobin muscles. It also helps in the conversion of hydrogen peroxide to oxygen and water	Reduced resistance to infection, productivity, physical fitness, anemia in children and women, pale eyes.	Men (10mg/day) Women (15mg/day)	Red meat, fish, eggs, legumes, dried fruits.
Zinc	Constituents of many enzymes, it enhances insulin activities, part of materials making genetic materials, helps to transport vitamins A. it improves mechanism and also helps in sexual maturation, improves appetite and promotes growth. Promotes rapid wound healing.	Growth retardation, DNA synthesis impaired taste and appetite, tiny penis, chronic wound healing prolonged acute or severe diarrhea.	Men 15mg/day, Women 10mg/day	Protein food sources meat, fish, whole grain, sea foods.

Iodine	It is an essential component of thyroid hormone that help to regulate growth and mental development. It also helps in the release of energy from the food consumed.	Growth retardation, cretinism and poor cognition in children. Severe form leads to goiter (enlarged thyroid gland).	150 ug/day	Iodized salt, sea foods.
Selenium	It is part of enzyme that work with vitamin E to fight free radicals in the body. It prevents degeneration of heart muscles.	Degeneration of heart muscles, susceptibility to cancer	70ug/day men, 55ug/day women	Sea foods, meat, onions, fruits.
Manganese	It serves as a cofactor activating a large number of enzymes, and also assist in the regulation of carbohydrate metabolism.	None yet	2-5mg/day	Widely present in foods
Copper	It is part of several enzymes, helps in Mitochondria energy production, Protects against oxidants and free radicals, plays key role in iron absorption and	Anaemia, weakening The nervous system.	1.5-3.0gm/day	Shell fish oysters, legumes, liver.



Chromium	It is part of insulin that helps to Transport glucose. It helps in the release of energy from glucose.	Impaired growth, Inability to use glucose normally	50-20ug/day	Meat, liver, kidney, whole grains.
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### 3.4 Definition of Vitamins

Vitamins are group of organic substances needed by the body in minute quantities but essential for normal metabolism, growth and development of the body. Vitamins like proteins, fats, oils, carbohydrates are organic substances but they differ from the large molecules. They are different because in their structures. Their individual units and are not linked in long chains. Vitamins do not yield any end product; they assist enzymes that yield glucose from carbohydrate, amino acids from protein and fatty acids, glycerol and glycerides from lipids. The amount of vitamins needed are measured in micrograms or milligrams instead of grams used for the large molecules.

### 3.5 Classification of Vitamins

Vitamins can be classified into two main groups. These two groups are fat and water soluble. The fat soluble vitamins are generally stable to heat and they can only be transported in the body in the presence of fat. The water soluble vitamins on the other hand, are not always stable to heat. They are easily decreased by heat or long storage.

These fat soluble vitamins are Vitamins A (Retinol), Vitamin D (Calciferol), Vitamin E (Tocopherol), and Vitamin K (Menaquinone and Phylloquinone). The water soluble vitamins are easily destroyed by heat. The water soluble vitamins are vitamins B1 (Thiamin), vitamin B2, (Riboflavin), vitamin B5 (Niacin or Nicotinic acid) vitamin B6, (Pyridoxine), vitamin B9 (Folic acid or folate), vitamin B12 (Cobalamin) and vitamin C (Ascorbic acid).

### 3.6 Stability, Key Functions, Deficiency, Food Sources and Requirements of Fat Soluble Vitamins.

**Table 3: Stability, key functions, deficiency, food sources and requirements of fat soluble vitamins**

Name	Stability	Key functions	Key deficiency	Food sources	Requirements
Fat soluble Vitamin A (Retinol)	Stable and destroyed by oxidation and ultraviolet radiation and heat	Essential for normal growth, reproductive system and normal vision, function as antioxidant.	Night blindness, poor tooth formation and severe deficiency leads to xerophthalmia	Liver, Egg yolk, Palm oil, Green and yellow leafy vegetables, yellow fruits.	5000 IU

<p>Vitamin D Calciferol</p>	<p>Stable to heat oxidation acid and alkali</p>	<p>Influences absorption and metabolism of phosphorus and calcium. Essential for normal growth, formation and maintenance of bones and teeth.</p>	<p>Bowlegs, poor teeth, knock knees, severe form leads to rickets in children and osteomalacia in adults.</p>	<p>Fortified milk, sunshine, liver, fish.</p>	<p>5-15mg or 400IU</p>
<p>Vitamin E Tocopherol</p>	<p>Stable to heat, in the absence of oxygen destroyed by alkalis</p>	<p>It is a strong anti-oxidant. Protects red blood cells from haemolysis, plays role in reproduction (in animals)</p>	<p>Increase in lipid peroxidation of the cell membrane, changes in balance and coordination. Sterility in animals</p>	<p>Wheat-germ, almond, plant oils, ground nut.</p>	<p>10-30 mg</p>

<p>Vitamin k Menaquinone and Phylloquinone</p>	<p>Resistant to heat, oxygen but destroyed by ultra violet light</p>	<p>Helps in the production of prothrombin a compound necessary for blood clotting. It is also involved in bone metabolism.</p>	<p>Lead to haemorrhage, increased incidence of hip fracture and slow clotting time.</p>	<p>Leafy green vegetables, soybean.  carrot,</p>	<p>120 mg</p>
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**Table 4: Stability, key functions, deficiency, food sources, and requirement of water soluble vitamins**

<p>Vitamin C (Ascorbic acid)</p>	<p>Unstable to heat, destruction by air, light and metals.</p>	<p>Important in wound healing, immune responses allergic reactions, collagen, formation, strengthening capillaries</p>	<p>Impaired wound healing, bleeding, gums, sore joints.</p>	<p>Citrus fruits, tomatoes</p>	<p>90mg for male 75 for female</p>
<p>Vitamin B1 (Thiamine)</p>	<p>Stable in acid solution</p>	<p>Assist in carbohydrate metabolism. Essential for growth, normal appetite, digestion and healthy nervous system</p>	<p>Loss of appetite, numbness in legs, irritability, depression and fatigue. Severe deficiency leads to beriberi.</p>	<p>Milk and dairy foods, organ meats green leafy vegetables.</p>	<p>1.1-1.3mg</p>

VitaminB2 (Riboflavine)	Unstable to heat, Light and alkaline (>pH7)	Helps in the metabolism of carbohydrates, amino acids, and lipids. Essential for growth. Helps in digestive system. Acts as hydrogenion transport.	Cheilosis, loss of Visual activity, Glossitis, alopecia Contributes to cataract formation	Milk and dairy foods, organ meals green leafy vegetables.	1.1-1.3mg
VitaminB5 (Niacinor Nicotinic acid)	Stable in presence of heat, oxygen, and alkali, light.	Part of coenzymes that Help in the metabolism of carbohydrates and amino acids. Helps in healthy gastrointestinal tract and nervous system.	Indigestion and anorexia, general weakness and tiredness, dermatitis, diarrhea and dementia.	Fish, liver, eggs, groundnuts, legumes.	14-16mg

<p>VitaminB6 (Pyridoxine)</p>	<p>Unstable to heat &amp;light.</p>	<p>Essential for normal growth. Asaco enzyme, it helps in the metabolism amino acids and unsaturated fatty acids from essential fatty acids. It aids in the conversion of tryptophantoniacin.</p>	<p>Convulsive seizures, anemia, weakness sleeping and poor mental perception.</p>	<p>Pork, yeast, Banana and liver</p>	<p>1.3-1.7mg</p>
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<p>VitaminB9 (Folate or Folic acid)</p>	<p>Stable in presence of light when insoluble, but unstable in presence of heat in acid media.</p>	<p>It helps in synthesis of genetic materials (DNA, RNA). It aids in the prevention of neural tube defects in early fetal development. Important in normal maturation of red and white blood cells.</p>	<p>Impaired biosynthesis of DNA and RNA. It leads to megaloblastic, macrocytic anemia. Neural tube defects.</p>	<p>Green-leafy vegetables, organ meats, legumes, oats.</p>	<p>400mg</p>
<p>VitaminB12 (Cobalamin)</p>	<p>Stable in acid, alkaline &amp; heat but destroyed by oxidation &amp; light (UV)</p>	<p>It aids in the normal blood formation. Important in the synthesis of genetic material. Promotion of growth and healthy nervous system.</p>	<p>Malabsorption leads to pernicious anemia, neurologic abnormalities.</p>	<p>Liver, milk, eggs, fish.</p>	<p>30mg</p>



#### **4.0 CONCLUSION**

In this unit, you have learnt that minerals can be classified under two groups, micro and macro minerals. You have also learnt the functions of these micro and macro minerals. The lists of these minerals have been introduced to you. By now you should know that minerals do not change in the body system, unlike organic compounds such as proteins and lipids. You should be able to select food sources for each of the minerals. More importantly, you should know the health implications of deficiencies of all these minerals. This unit has also defined and classified vitamins. The unit has shown that vitamins are organic substances like the three large molecules (carbohydrates, proteins & lipids) but they are different from them. Vitamins have been grouped into two major groups (fat and water soluble). Their functions, deficiencies, food sources and vitamin requirements were explained in this unit. By now you should begin to pay attention to your food intake as to whether it supplies you all the vitamins for your optimal health.

#### **5.0 SUMMARY**

This unit still being part of basic nutrition, has taken you through the importance of macro and micro minerals in the promotion of good health. The unit has also illustrated the difference between micro and macro minerals. The chief functions, deficiencies and food sources have also been discussed. The unit discussed the vitamins, another important nutrient that promotes quality health. It has expatiated on the importance of vitamins in assisting other nutrients to promote and sustain healthy body system. The unit has also discussed the two groups of vitamins, their functions, deficiencies and food sources.

#### **6.0 TUTOR-MARKED ASSIGNMENTS**

- 1a. Distinguish between macro and micro minerals
- b. Describe the principal functions, two food sources and deficiencies each of macro and micro minerals.
- 2a. Describe the general differences between fat and water soluble vitamins.
- b. Which of the B vitamins are associated with energy and protein metabolisms list at least two deficiencies of these vitamins.

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## UNIT 5 WATER AND FIBER

### CONTENTS

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Definition and Classification
  - 3.2 Functions of water
  - 3.3 Effects of water on nutritive value of food
  - 3.4 Recommended Daily Requirement for water
  - 3.5 Dietary Fiber
  - 3.6 Differences between Starch and Fiber
  - 3.7 Classification, Functions of Dietary Fiber
  - 3.8 Functions or Health Benefits of Dietary Fiber
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Readings

### 1.0 INTRODUCTION

Since the first five units have introduced you to basic nutrition, you should by now appreciate that all the nutrients are needed for well being of humans from the womb to old age. Apparently, when discussing about nutrients, for planning adequate nutrition, water is often left out as one of those nutrients to be reckoned with. Whereas, human being can survive a longer period without food than without water. Water is the main constituent of the body, comprising 72% of fat free weight – about 45 litres in the average 70kg man, and slightly less in the average woman of this weight because of greater proportion of body fat. Of these 45 litres, about 30 are intracellular fluid (ICF) and 15 are extracellular fluid (ECF), and of the latter volume about one-fifth, or 3 litres, is plasma water within the intravascular space. Transcellular fluids (e.g. cerebrospinal fluid, fluids in the eye and ear, intestinal secretions) comprise further small parts of the ECF compartment, but have slightly different ionic structures owing to the selective properties of the organs secreting them. Since you have been exposed to other 6 important nutrients, you will realize that all these nutrients are in the foods that you consume and all of them have specific roles they play in nourishing the body. This unit shall illustrate the importance of fiber, an essential nutrient that is under appreciated and often mentioned as part of components of adequate nutrition intake. Burkitt and Trowell (1972), had earlier proposed that many Western diseases such as cardiovascular

diseases, diabetes, some forms of cancers and obesity were due to lack of dietary fiber in the diet.

This unit intends to discuss the importance of water, its classification, functions and sources. It also explain the types of dietary fiber, its health benefits and food sources.

## **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- Define water in your own words.
- Describe the classification of water.
- Identify at least three functions of water.
- Describe the effects of water on nutritive value of foods.
- List two sources of water.
- Describe Daily Recommended Allowances for water.
- Define dietary fiber in two ways
- Differentiate between fiber and starch
- List at least three health benefits of dietary fibers.
- Identify at least two major food sources of each type of dietary fiber

## **3.0 MAIN CONTENT**

### **3.1 Definition, Classification and Sources of Water of water**

Water is defined as tasteless, colourless, odourless and clear fluid that is made up of hydrogen and oxygen. It can be classified as either hard or soft. Water is either hard or soft depending on the source of the water.

The two main sources of drinking water are surface and ground water. Surface water comes from lakes and rivers. The ground water, on the other comes from underground rock. The vast majority of the people in rural and some parts of the urban areas draw water from the well. The two sources of water are exposed to contaminated wastes, pesticides, chemicals and poorly disposed household solvents. The level of chemical present in water will determine the level of the hardness of the water.

### **3.2 Functions of Water**

- Water supports life, without it human being cannot survive.
- Water serves as intracellular and extracellular fluid.
- It forms a good medium for removing heat from the body because it has great ability to hold heat.

- It helps to remove waste products from the body.
- It serves as lubricant in the knees and joints of the body.
- It is used for the construction of every cell.
- Water forms the major part of foods and human body.
- It serves as a solvent for nutrients; it liquefies food so that it can be properly digested.

### **3.3 Effect of water on Nutritive value of food**

The quantity of water in a food has a great effect upon other nutrients in such food. Fruits and some green leafy vegetables, have higher quantity of water and lesser energy and other nutrients than dried fruits and leafy green vegetables. The quantity of water, in order words, affect the total energy value in the food because of dilution. The same principle applies to protein and other nutrients.

### **3.4 Recommended Daily Water Requirements for Water.**

You should remember that almost two thirds of the body is made up of water, hence the need for daily regular intake of water is compulsory. An average individual requires about two litres or eight cups of water on daily basis. You should also note that water is also abundant in some foods such as fruits and leafy green vegetables (cucumber, lettuce, raw tomatoes, orange, grape, water leaf, okra). The body also makes its own water from the byproduct of carbohydrates, fats and protein metabolism.

### **3.5 Definition of Dietary Fibers**

Trowell (1972) defined dietary fiber, as “The skeletal remains of plant cells that are resistant to hydrolysis by the enzymes of man”. This specific focus on the skeletal remains of plant cells deliberately excluded starch and other non cell wall materials, and provided the source definition of dietary fibre as endogenous plant cell wall material (Trowell 1972, Trowell et al 1985). The Life Science Research Office (1987) also defines dietary fiber as “the endogenous components of plant materials in the diet which are resistant to digestion by enzymes produced by humans”.

Whitney, Cataldo and Rolfes (1998) also defined dietary fiber as the structural parts of plants and are found in all plant – derived foods – vegetables, fruits, grains, and legumes”. Wardlaw also defines dietary fibers as “a class made up of polysaccharides, but they differ from starches in so far as the chemical links that join individual sugar units cannot be digested by human enzymes in the gastrointestinal (GI) tract”.

### 3.6 Differences between Starch and Fiber

In plants, glucose is stored as starch in the plant cells, just as the human body stores glucose as glycogen. Although both starch and fiber are polysaccharides, fibers differ from starch because the bonds between their monosaccharide units cannot be broken down by human digestive enzymes. Starch, on the other hand, is digestible by human digestive enzymes. The connecting chains in starch are in spiral form, whereas, in fiber it is straight.

### 3.7. Classification of Dietary fibers

Total dietary fiber can be broadly divided into two, non-starch polysaccharides and Lignin. Lignin is a non-polysaccharides fiber that gives the plant its strength. Lignin is an insoluble fiber , examples are whole grains, parts of vegetables such as carrots or the small seeds of fruits.

The non-starch polysaccharides are further divided into non-cellulose polysaccharides and cellulose. Like starch, cellulose is made up of glucose units. They are connected in a long chain and this chain does not branch. The bonds holding the glucose units together resist digestion by human digestive enzymes. Cellulose is the primary constituent of plant cell walls and hemicelluloses are the main composition of cereal fibers (wheat, brown rice, vegetables). Both cellulose and hemicellulose are insoluble in water.

It is apparent from the above that further division of dietary fiber can be grouped under soluble dietary fiber. The soluble dietary fibers include pectins, gums, and mucilages. Pectins are found in vegetables and fruits, especially citrus fruits, apples, banana, oranges, carrots, oats, and kidney beans. Remember that gums and mucilages are the secretion that comes out when a branch of plant is cut.

### 3.8 Functions or Health Benefits of Dietary Fiber and Food sources

**The health benefits of soluble dietary fiber include;**

1. Delaying the stomach's emptying and the transit of chyme (through the intestine).
2. Delay glucose absorption
3. Lower blood cholesterol

The health benefits of insoluble dietary fiber include:

4. Speed up the transit of chyme through the intestine (whole grains).
5. Increase fecal weight.
6. Slow starch breakdown and delay glucose absorption into the blood.

#### **4.0 CONCLUSION**

This unit has actually discussed water as the sixth important nutrient that is required by the body for optimal functioning. Whereas, most health experts ignore water as a nutrient. By now, you should know that water is even the most important nutrient for the body. Water has been classified into two groups and its functions have been well listed in this unit. The Recommended Daily water Requirement has been put at 2 litres or 8 cups. Other sources of water from the food metabolisms and fruits and leafy green vegetables have also been explained. The effect of water on nutritive value of food is not left out in this unit.

It has also shown that dietary fibers are important nutrient but unrecognized in human diet. Five different definitions have been given. At this juncture, you should define your dietary fibers in your own words. The unit has expatiated between starch and dietary fiber. It has also classified dietary fibers. The functions or health benefits of dietary fibers have been illustrated under soluble and insoluble dietary fibers with specific examples of food sources.

#### **5.0 SUMMARY**

Water as an important and as an indispensable nutrient have been examined in this unit. Its functions, sources, effect on nutritive value of food and daily requirement have been presented in this unit. This unit being part of the last one to end up knowledge of basic nutrition, has taken you through the meaning of dietary fibers, compositions, difference between starch and dietary fiber and health benefits of soluble and insoluble dietary fibers together with their food sources. It is hoped that you will make good use of this basic knowledge in Nutrition as you move to the next module.

#### **6.0 TUTOR-MARKED ASSIGNMENT**

- 1a. Define water in your own words.
- b. List two classes of water.
- c. Enumerate 5 functions of water.
  
- 2a. Describe the differences between starch and dietary fibers.

- b. With specific examples of food sources and their classification, list three health benefits of dietary fibers.

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### **MODULE 3            FOOD CLASSIFICATION, PURCHASING, PREPARATION, PRESENTATION AND COMPLEMENTARY FEEDING**

Unit 1	Food Classification
Unit 2	Food Purchasing
Unit 3	Food Preparation
Unit 4	Food Presentation
Unit 5	Preparation of Complementary Feeding for young children

#### **UNIT 1            CLASSIFICATION OF FOODS**

##### **CONTENTS**

1.0	Introduction
2.0	Objectives
3.0	Main content
	3.1    Classification of foods
	3.2    The Importance of food classification
4.0	Conclusion
5.0	Summary
6.0	Tutor-Marked Assignment
7.0	References/Further Readings

#### **1.0    INTRODUCTION**

Since you have learnt about food, its definition, meaning and functions, in Module 2, you are going to be introduced to classification of foods in this unit. This classification of foods will assist you use food composition tables. These tables are organized according to classification of foods into food groups, with the food items listed alphabetically within each food group. Bread, for example, tops the cereal food groups. You will be introduced to different ways of classifying foods both internationally and nationally.

#### **2.0    OBJECTIVES**

By the end of this unit, you will be able to:

- Classify foods into five different ways.
- Describe each classification in your own language with specific examples of locally available foodstuffs.
- List at least two importance of classification of foods.

### 3.0 MAIN CONTENT

#### 3.1 Classification of foods

Foods can be classified into five different ways. These are the Basic four, the 7 food groups, Nutrients, Food Guide Pyramid and 3 Food Groups.

The Basic Four: This is an American acceptable method of classifying foods.

The Basic Four Groups are Milk and milk products (milk, ice cream, and cheese);

Meat and legume group (Beef, veal, pork, lamb, poultry, fish, eggs, dry beans, peas, soybeans, melon seeds, and groundnuts as alternatives).

Vegetable and fruits Group (Citrus fruits, leafy green vegetables).

Grains and Cereals group (whole grains that include maize, millet, oats, wheat, guinea corn and rice).

The 7 Food Groups: This 7 food groups plan was introduced during the war time.

#### These groups are:

- ? green and yellow vegetables (amaranthus, water leafy, red potato leaves, red spinach).
- ? Oranges, grapefruit, tomatoes or raw cabbage. Potatoes, other vegetables and fruits.
- ? Meat and milk products. Meat, poultry, fish and eggs.
- ? Bread, flour and cereal (whole grain enriched or restored). Butter or fortified margarine.

Just like the Basic four, the 7 food groups was used in United States of

#### America.

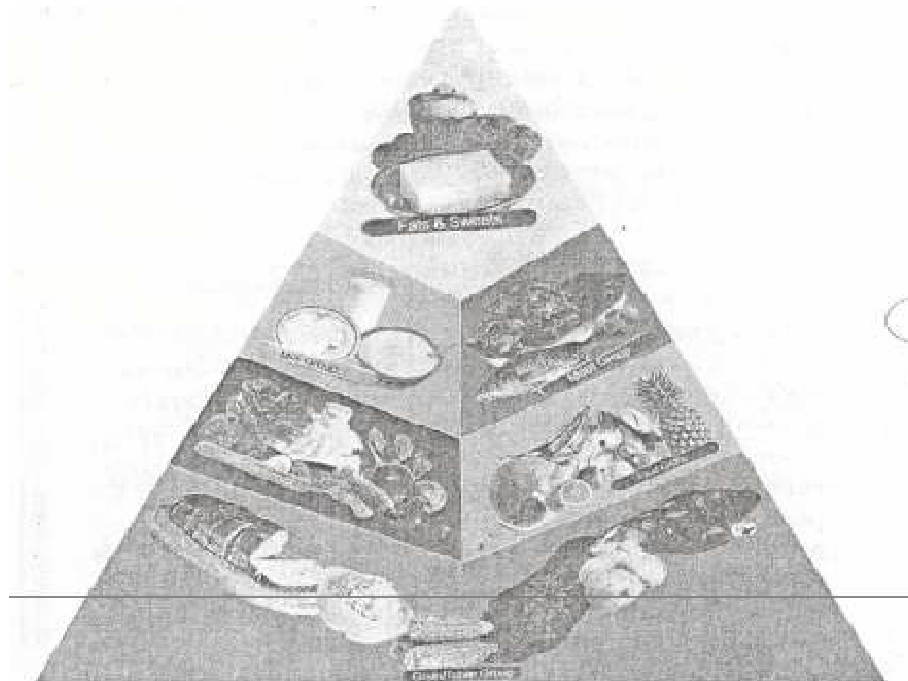
#### Nutrients Classification

Food classification can also be grouped according to the major nutrient such food is made up. These nutrients are carbohydrates (yam, cassava); Protein (meat, fish, beans); Fats and oils (palm oil, corn oil, olive oil); Vitamins, Vitamins A,B, C and D (fruit and vegetables) Minerals, zinc, iron, calcium (milk, nuts, fish) water (rain water, bore-hole water). Fiber (fruits, vegetables and beans).

## Food Guide Pyramid

The food Guide Pyramid was developed to help individuals to choose an adequate and healthful diet. The food guide Pyramid shows at the base of the pyramid bread, whole grain cereal, and at the top of pyramid are fats, oils, sweets meaning that to have an adequate diet, one should eat more of the food at the base and consume very minimal of those at the apex of the pyramid. In the middle of the pyramid fruits and vegetables are encouraged to be consumed at least 2 to 4 servings every day. The third layer has meat and milk products and they should be consumed at least 2 servings daily.

### FOOD PYRAMID



**Fig. 10.1: Food Pyramid**  
Courtesy of Olu Akinkugbe Foundation Child Nutrition Centre

<p><b>GRAIN GROUP</b> 1 Slice of Bread 1 milk tin of cooked/prepared rice ½ cup of cooked cereal</p>	<p><b>VEGETABLE GROUP</b> 1 serving of chopped raw or cooked vegetables 1 serving of leafy vegetables</p>
<p><b>FRUIT GROUP</b> Generous amount of any fruit in season 1 cup of fresh fruit juice</p>	<p><b>MILK GROUP</b> 1 cup of milk 1 serving of cheese</p>
<p><b>MEAT GROUP</b> 2 to 3 peices of cooked lean meat, poultry or fish. ½ milk tin of cooked dry beans or 1 egg</p>	<p><b>FATS AND SWEETS</b> Eat less of these</p>

## **The 3 Food Groups**

The 3 Food groups are actually the classification that is appropriate for our environment. The 3 Food groups are energy giving food group (yam, bread, cassava, beans). This group of food majorly supplies energy to the body.

The second group is Body Building food groups (fish, meat, beans, oil seeds, and insects). These groups of food supply protein which the body needs for building new cells and repair worn out tissues. Remember that this is protein which is part of your Basic knowledge in nutrition in Module 2.

The third group is Protective food groups. These are vitamins and minerals that help the body to ward off infection and also serve as antioxidants.

### **3.2 The Importance of Food Classification**

The advantages of food grouping include the following:

- It encourages consumers to eat healthily.
- It shows those food items consumers should be taking in adequate quantity and those that should be taken with caution.
- It describes the function of each nutrient at a glance (energy giving or bodybuilding food groups).
- It serves as a graphic representation of those foods to be taken minimally (sugar, ice cream, and other sweets, the tip of food Guide Pyramid).
- It shows number of servings attached to each group (Food Guide Pyramid).
- It provides daily food Guide.

## **4.0 CONCLUSION**

In this Unit, you have learnt that food can be classified in different ways. This classification of foods includes the Basic 3 Food Groups, the Basic Four Groups, The 7 Food Groups, the Nutrients classification, and the food Guide Pyramid. These five grouping of foods are discussed with specific examples. By now, you should be able to plan an adequate diet using the 3-Food groups and the Food Guide Pyramid.

## 5.0 SUMMARY

The unit has presented five distinct different ways of grouping foods with specific examples. The unit has also explained the usefulness of food classification.

## 6.0 TUTOR-MARKED ASSIGNMENT

- \* List three methods of classifying foods with specific locally available foodstuffs.  
Name four groups in the Daily Food Guide Pyramid and identify at least three food items of each group.

## 7.0 REFERENCES/FURTHER READING

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## **UNIT 2      FOOD PURCHASING**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main content
  - 3.1 The Need for Food and Its Cost
  - 3.2 Determinants of Food Purchasing
  - 3.3 Appropriating Money for the 3-Food Groups
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Readings

### **1.0 INTRODUCTION**

In Unit 1, you have learnt different ways of classifying foods in order to assist you in knowing types of food groups you should purchase when you go to the market. Since we have built the foundation of having an adequate nutrition, this unit shall deliberate of some of the principles that can help you to purchase foodstuffs wisely for healthy dietary intake for the family.

### **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- identify people who specially need protein and energy.
- list at least three determinants of food purchasing
- describe the principle of buying in quantity.
- identify factors that should be taken into consideration in food budgeting
- apportion money value to each of the 3-food group.

### **3.0 MAIN CONTENT**

#### **3.1 The Need for Food and Its Cost**

In earlier units, you have learnt the functions of food as an edible, digestible, absorbable and utilizable substance that nourishes the body for optimal growth. The need for this food varies from one group to another. Of all the nutrients that the food supplies, proteins and energy stand out as crucial dependency on the physiological and physical condition of the individual. Remember, that fats, vitamins and minerals are also important to maintain, restore and promote quality health.

Pregnant mothers, nursing mothers and young children specially need protein than the adults. In terms of energy, the need for this nutrient depends on the activity levels. A growing child, a hard working farmer, or a mechanist needs more energy than a sedentary person. Both protein and energy are derived from the foods you buy in the market and there is a price for each food item.

### **3.2 Determinants of Food Purchasing**

In shopping wisely for food items some factors should be taken into consideration. These factors include: nutrition values of foods, family income, family size and composition, house wife's level of education, family food budget, quantity of food purchased, ability to shop around, food prizes and food seasonal variations and food storage facilities.

**Nutritional Values of foods:** In shopping wisely, the house wife's educational background is very important. The educational background will certainly permit her to have some ideas about foods that will support her family's health. Family income is definitely important in purchasing food items for the family. Low income families cannot afford to buy very expensive bodybuilding food groups such as beef, eggs, stock fish and other meat and dairy products on daily basis. but with a good knowledge in basic nutrition, the house wife can still find a substitute for the expensive meat. Beans and rice with crayfish can still meet the requirement for protein needs of the family.

**Family size and composition:** The larger the family, the more food the family needs. When the composition of the family is made up of growing children, nursing or pregnant mothers, the more food such a family requires. **Family food budget:** One of the main aims of food budgeting is to ensure that adequate diet is provided to every member of the family, regardless of the condition of the family income.

**Buying Food in quantity and shopping around for food** will certainly reduce the money spent on food purchasing. Shopping around will permit the housewife to know where certain food items are cheap. Seasonal variation in food prices also affects the amount spent on food. During raining season, there are plenty of foodstuffs but during the dry season, on the other hand, foodstuffs are scarce and costly. In the wet season, fruits and leafy green vegetables are plenty and cheap and very costly during the dry season.

**Storage facility of food stuffs during the raining season** when foodstuffs are plenty becomes a crucial issue is reducing cost of food during the dry season.

### **3.3 Appropriating Money for the 3-Food Groups.**

You will recall that you have learnt in Unit 1, that the 3-food Groups is the classification of food that applied to our environment. Of the three groups, half of the money budgeted for food should go to body building food group and one-quarter each goes to energy and protective food groups.

Half of the money budgeted for food has to go to body building food groups because this group is very essential for normal growth and development. It is also vital in maintaining worn out tissues in both adults and children.

### **4.0 CONCLUSION**

In this unit, you have learnt that those people that need more protein and energy are the pregnant women, nursing mothers and young children. The determinants of food purchasing have also been discussed extensively. Some of these determinants include family income, family composition, nutritional values of foods, housewife's educational level, food storage, family food budget, buying food in quantity, and distribution of money to the 3-food groups.

### **5.0 SUMMARY**

This unit has described the various factors that influence effective food purchasing in order to guarantee adequate diet for the whole family. The house wife who is the food gatekeeper is the principal actor in food purchasing.

### **6.0 TUTOR-MARKED ASSIGNMENTS**

1. List five determinants of food purchasing.
2. A mother of two children under five years of age and her husband have come to you for an advice on how to budget the sum of ten thousand naira on food for a month. Briefly state how you would assist the family in money allocation to the different food groups and list some of the food items you will advice her to purchase.

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## **UNIT 3      FOOD PREPARATION**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Rationale for Cooking Foods
  - 3.2 Methods for Food Preparation
  - 3.3 The Danger of Handling of food Items during food preparation
  - 3.4 The Effects of food Preparation on the Food Nutrients.
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/Further Readings

### **1.0 INTRODUCTION**

Since you have been introduced to food classification and purchasing, you should have had some ideas on how to select food from the food groups based on both the nutritive values and cost. This unit is all about methods of food preparation and their effects on the nutrients and the hygienic effects of such methods on human beings.

### **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- list at least two rationales for cooking foods. identify three methods of food preparation
- describe the possible effects of poor food handling during food preparation
- describe the effects of food preparation on the food nutrient
- list two non-communicable chronic diseases that may affect humans due to method of food preparation.

### **3.0 MAIN CONTENT**

#### **3.1 Rationale for Cooking Foods**

You will recall that the Homosapiens in the early century were food gatherers and they did not cook their foods until later century. All their foods were eaten raw. The agricultural and industrial revolutions had brought a lot of changes to both food processing and preparation. Most of the foods have to be cooked for the following reasons:

Cooking of the food will destroy all pathogenic (disease causing) agents such as bacteria and virus. Cooking the food such as meat, grains (rice, wheat, maize, guinea corn, legumes (beans, lima beans), and tubers will make these food items palatable.

Cooking the food makes the texture soft and easily digestible and utilizable in the body system.

### **3.2 Methods of Food Preparation**

Prior to cooking the food, the food items may have to be washed, hulled or peeled, chopped, pounded, soaked, or squeezed. Smoking, baking, roasting, grilling, stewing, steaming, boiling, and frying of foods are methods of preparing food. Some of these methods have adverse effects on human beings. Smoking leaves black smoke on the food, while frying may lead to excess intake of fats in the body system. Excessive intake of fat may lead to cardiovascular disease or obesity.

Of all the methods of preparing foods, boiling, steaming and baking are acceptable because these methods help to preserve some vital nutrients in the foodstuffs.

### **3.3 The Danger of Poor Handling of Food Items During Food Preparation**

Food borne illness is one of the major adverse effects of poor handling of food during preparation. Prevention of food borne illness can be prevented by keeping hot foods hot, cold foods cold and keeping hands, utensils, raw foodstuffs and kitchen clean. Meat and seafood must be cooked very well. Keep cold food at 40oF or less and keep frozen foods at 0oF or less. Washing of hands and all cooking utensils before cooking will definitely help to prevent food borne diseases. Salmonellosis is a food borne illness due to consuming raw or under-cooked eggs, meats, and dairy products. Hepatitis is also food borne illness caused by eating under cooked or raw shell fish.

### **3.4 The Effect of Food Preparation on the Food Nutrients.**

Regardless of the methods used in food preparation, some nutrients are lost, especially water soluble vitamins are lost during food preparation. The method of preparing corn pap for the children through sieving of the wet milled corn, most of all the vital nutrients such as protein, minerals and vitamins are lost. The frying of palm oil leads to the loss of beta-carotene in the palm oil.

#### **4.0 CONCLUSION**

This unit has discussed the rationale for food preparation and different methods of food preparation. The unit has also explained the adverse outcome of poor handling of food during food preparation. Specific food borne illness due to poor food handling and effects of food preparation on the nutrients are illustrated.

#### **5.0 SUMMARY**

In this unit, you have been taken through the importance of cooking food methods of preparing foods for healthful consumption. The effects of various methods of preparing these foodstuffs from nutrients loss have also been discussed.

#### **6.0 TUTOR-MARKED ASSIGNMENTS**

1. Distinguish between two types of food preparation and their effects on the food nutrients.
2. What special precautions would you apply in preventing food borne illness in your family?

#### **7.0 REFERENCES/FURTHER READINGS**

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## **UNIT 4      FOOD PRESENTATION**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Definition of Food Presentation
  - 3.2 Rules for food presentation
  - 3.3 Tips for food presentation
  - 3.4 Tips for food presentation plating
  - 3.5 Tips for food Garnishing
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/Further Readings

### **1.0 INTRODUCTION**

The three previous units have discussed food grouping, purchasing and preparation. This unit is concerned about food presentation. You will recall that in module one, we learnt that Nutrition is a science as well as an art. The art aspect of nutrition is the presentation of food after it has been prepared for consumption. Regardless the quality of a diet, if the presentation is not appealing, it is of no use. Food presentation is an important aspect of ensuring adequate diet.

### **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- define food presentation
- differentiate between African and western food presentation list at least three of the primary rules of food presentation
- list at least four tips for plating
- identify two garnishing tips.

Plan a food presentation that is acceptable using locally available foodstuffs.

### **3.0 MAIN CONTENT**

#### **3.1 Definition of food Presentation**

Food presentation is the act of presenting the foods prepared in a plate. This presentation can be appealing or not appealing. Food presentation

is an important part of dining experiences, especially in Western World. Food presentation in a plate is full of different food items in small quantities, with at least three different colourful foodstuffs. A plate of food may contain a piece of sweet potatoes, carrot, leafy green vegetable, chicken or fish and rice. These food items are arranged orderly and looking at the plate, will certainly stimulate the sense of taste, after all, we eat with our eyes first.

The African food presentation is different from the western world because it does not have variety in the plate. It is either a solid tuber product (pounded yam, yam flour meal, cassava meal) or grain product (rice, corn, pap, solidified millet, wheat or guinea corn). This solid food is eaten with either vegetable, melon or okra soup). There is no variety of colour in the plate.

### **3.2 Rules for food Presentation**

The rules for food presentation are:

- Inclusion of variety of foods with different textures that will stimulate all the senses. The senses of feeling or touching should be felt.
- Visual appeal: The food presentation should be appealing to the consumers. By using different food items with different colours (carrot, sweet potatoe, garden egg, leafy green vegetable) will certainly stimulate the other senses.
- Smelling Appeal: Food presentation should have appeal to the sense of smell.
- This sense arouses the sense of taste of the food. Flavours and types of food used will help to give appealing aroma.
- The sense of sound: A good food presentation should have the quality of sound in the form of crushing e.g. inclusion of apple or hard pawpaw.
- The sense of taste: An ideal food presentation should be tasty in the mouth.
- These five senses must be fulfilled for an ideal food presentation.

### **3.3 Tips for food presentation Plating: The following tips on plating of food should be considered for an appealing food presentation.**

- \* planning of the diet is very crucial. Food purchasing should be planned ahead of time for either daily or occasional meal.
- \* Having a bigger plate is better since this will disallow crowding of food items.

- \* Colouring the plate makes the food appealing. This can be achieved by using different food items of different colours.
- \* Finding a focus of the meal is equally important. Ideally the protein should be focal point of the meal.
- \* Serving of hot foods hot, on hot plates and serve cold food cold, in cold plates.

### **3.4 Tips for Food Garnishing**

Garnishing is an attempt to add colour or flavour to make the dish appealing and tasty. Garnish brings the food together. Examples of garnish items are fresh herbs, chocolate, lemons, mints etc. Tips for garnishing include:

- Garnishes should be edible.
- They should be complementary to the ingredients you are using.
- The uses of fresh herbs will instantly show visual appeal, colour, flavour and fragrance to the food being presented.
- Using of chocolate, lemon, or orange for food being prepared to add flavour.

### **4.0 CONCLUSION**

Since you have gone through this unit, you have learnt that food presentation is an important aspect of adequate dietary intake. The unit has also shown that food presentation should appeal to the five senses. Tips for food presentation plating and food garnishing are also discussed.

### **5.0 SUMMARY**

The unit has defined food presentation, its importance in taking adequate nutrition. The unit has also discussed the difference between African and western food presentation. The rules governing food presentation have been highlighted. Suggestions as to plan food presentation on plating and tips on food garnishing are also illustrated in the text.

### **6.0 TUTOR-MARKED ASSIGNMENTS**

1. Define food presentation in your own work
2. Describe two of the human senses that may affect food presentation

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## **UNIT 5      PREPARATION OF COMPLEMENTARY FEEDING**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main content
  - 3.1 Definition of complementary feeds
  - 3.2 Reasons for complementary feeding
  - 3.3 Characteristics of complementary foodstuffs
  - 3.4 Anti-Nutritive inhibitors in commonly used complementary feeding
  - 3.5 Preparing complementary feeding
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignment
- 7.0 References/Further Reading

### **1.0 INTRODUCTION**

In developing countries, most children begin to experience childhood malnutrition from seven months upwards because breast milk can no longer meet the nutrients requirements of these growing infants. Micronutrients such as iron, Vitamin A and calcium are deficient in these growing infants after 6 months of age. In an attempt to ensure optimal growth among young children, other foods from the environment should be given to these growing infants together with breast milk. These foodstuffs being given to the infants in addition to breast milk is known as complementary feeds. The complementary feeding is to compliment breast feeding. The types of foodstuffs to be used as complimentary foods depend on availability, socio-cultural and religious food taboos of the nursing mothers. In this unit you will learn the principles, properties and formulation of complementary foods.

### **2.0 OBJECTIVES**

At the end of this unit, you will be able to:

- define complementary feeding
- differentiate between weaning and complementary feeding
- identify two of the reasons for complementary feeding for infants aged six months and above
- list at least three properties of a good complementary foodstuff.
- identify two anti-nutritive inhibitors in complementary foods using locally available foodstuffs.



### **3.0 MAIN CONTENT**

#### **3.1 Definition of Complementary feeds**

Complementary feeding is the addition of other foods or liquid to the infants foods while the mother is still breastfeeding. This complementary feeding usually commences after the age of six months when exclusive breastfeeding has stopped. There is a difference between the term weaning and complementary weaning.

Weaning is the gradual or total withdrawal of breast milk from the infants. Complementary feeding does not displace breastfeeding rather it complements it. The term weaning connotes total stoppage of breast feeding. The term weaning has now been replaced with complementary feeding.

#### **3.2 Reasons for complementary feeding for infants six months and above**

It is very vital to note the reasons for ensuring quality complementary feeds to infants six months and above:

- Both recent and previous studies have shown infantile malnutrition begins from seven months of age.
- Growth faltering: The child's growth pattern lags behind normal age group due to deficiencies in energy.
- Micronutrients deficiencies. The quality of breast milk in terms of micronutrients begins to decline from 7 months of age of the infants. Essential micronutrients include zinc, iron, selenium, vitamin A.

Exposure to plethora of infections: Infants after the age of six months are exposed to plethora of infectious diseases such as measles, diarrhea, and viral and upper respiratory infections.

#### **3.3 Characteristics of complementary foodstuffs**

- o The characteristics of complementary foodstuffs are as follow:
- o It should be safe (washing hands before preparation and before feeding it to the infants. It should be kept in a clean place).
- o It should be adequate in protein to support and sustain optimal growth.
- o It should supply enough energy to meet the infant's daily energy requirements.
- o It should be rich in micronutrients and other minerals and vitamins to meet the infant's rapid growth.

- o It should be free from contamination (pathogens, toxins, or harmful chemicals).
- o It should be culturally and religiously acceptable
- o There is Ischaemic heart disease and dietary fibre should not be hot spices added to the complementary foodstuffs.
- o The complementary food should be a combination of varieties of locally available and nutritious foodstuffs.

### **3.4 Anti-Nutritive Inhibitors in commonly used complementary foodstuffs.**

Most of the foodstuffs used for complementary feeding (maize, millet, guinea corn, maize flour) contain phytate, tannins and phytic acid. Legumes and oil seeds (cowpeas, pigeon, peas, locust bean, groundnut, soybeans, cotton) contain oxalate, trypsin and tannins. All these anti nutritive inhibitors are usually in the foodstuffs that make the minerals in the legumes and grains unavailable to the body system. Some of the ways to remove these inhibitors are by soaking, fermenting, dehulling and drying the foodstuffs before they are used.

### **3.5 Preparing Complementary Feeding**

The most popular complementary food in Nigeria is corn/maize, guinea corn or millet. The protein content of this grain ranges from 7 to 10 percent, but by the time it is given to the infants, it is reduced to less than 1 percent because of sieving during preparation. Ideally, the grain should not be sieved after wet milling. A good complementary foodstuffs should be a combination of legumes and grains. Both legumes and grains/cereals complement each other. Grains/cereals supply methionine (an essential amino acid that the body needs for proper growth) to legumes. Legume on the other hand, supplies lysine, which grains lack.

Examples of complementary food include:

Wheat pap combined with cowpea beans. Corn meal combined with black eyed beans paste. Guinea corn with soya bean. Corn meal combined with roasted ground nut paste.

Millet with groundnut paste.

## **4.0 CONCLUSION**

In this unit, you have learnt the meaning of complementary feeding and that it has to replace the term weaning. By now, you should be able to define the two terms in your own words. The importance of complementary feeding for infants from 6 months upwards has been

discussed. The characteristics of complementary foodstuffs and the effects of anti-nutritive inhibitors have also been explained. Finally, examples of complementary foodstuffs are also illustrated.

## **5.0 SUMMARY**

This unit has described the importance of complementary feeding as complement to breast feeding. The properties and examples of complementary foodstuffs have also been discussed.

## **6.0 TUTOR-MARKED ASSIGNMENTS**

1. Differentiate between weaning and complementary feedings.
2. List three reasons for prescribing complementary feeding for infants aged 6 months upwards.

## **7.0 REFERENCES/FURTHER READING**

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**MODULE 4           ASSESSMENT OF NUTRITIONAL STATUS,  
NUTRITION EDUCATION, NUTRITIONAL  
CARE IN DISEASE, NUTRITIONAL  
CARE FOR ENERGY MALNOURISHED  
CHILDREN, NUTRITIONAL CARE FOR  
HYPERTENSIVE PATIENT AND  
NUTRITIONAL CARE DIABETIC  
PATIENT**

Unit 1	Assessment of Nutritional Status
Unit 2	Nutrition Education
Unit 3	Nutrition Care in Disease
Unit 4	Nutrition Care for Protein Energy Malnourished Children
Unit 5	Nutrition Care for Hypertensive Patient and Diabetes Patients

**UNIT 1           ASSESSMENT OF NUTRITIONAL STATUS**

**CONTENTS**

1.0	Introduction
2.0	Unit Objectives
3.0	Main Content
3.1	Technique in Assessing nutritional status
3.2	Anthropometric Technique
3.3	Biochemical Assessment
3.4	Clinical Assessment
3.5	Dietary Survey
3.6	The Usefulness of Anthropometric Indices
4.0	Conclusion
5.0	Summary
6.0	Tutor-Marked Assignments
7.0	References/Further Reading

**1.0    INTRODUCTION**

Since you have had some background knowledge in basic nutrition, it is important to apply this knowledge to improve your health and others. In this unit, you will be exposed to nutrition assessment of an individual. You ought to have had the knowledge of assessing the status of the nutritional status of an individual or group prior to providing information on ways to improve the nutritional status.

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- define nutrition assessment
- list at least three methods of assessing the nutritional status of an individual
- calculate and interpret data obtained from anthropometric technique
- identify at least two usefulness of anthropometric indices.

## 3.0 MAIN CONTENT

### 3.1 Techniques in Assessing Nutritional Status

Basically there are four methods of assessing nutritional status. These methods include anthropometric, biochemical, clinical and dietary survey techniques.

### 3.2 Anthropometric Technique

This method measures weight, height, middle upper arm, chest circumferences and skin fold thickness. The tools needed for anthropometric measurement are weighing scales, calibrated fibre tape, Herpenden's caliper and meter rule. Adults are usually assessed by using their height, body weight, skin folds, waist and hip measurements. Middle upper arm, chest and head circumferences, weight gains are employed for children especially, under five children. The major anthropometric technique to assess the adults are Body Mass Index (BMI), waist-hip ratio (WHR); Waist-height ratio (WHR) and skin folds thickness.

The BMI describes generalized body fatness for the adult. It is calculated by dividing the weight (kg) by height (m) squared. BMI for adults can be numerically classified as shown below:

< 18.5 -	underweight
18.5 - 24.9	Normal
25.0 - 29.9	overweight
30.0 - 39.9	obese
> 40.0	morbid obesity

Waist-Hip Ratio (WHR): WHR measures central or abdominal obesity. It is calculated by dividing the waist size by the hip measurement. In females WHR should be less than 0.81 for normal WHR and anything above 0.81 is an indicator of obesity. In males, the ratio should be less than 1, anything above this ratio is a sign for abdominal obesity. Waist-height ratio for both males and females should not be greater than 0.50.

### **3.3 Biochemical Assessment**

This method requires the taking of blood, urine, stools samples, finger nails, or hair to determine the protein, fat, or vitamins contents, Biochemical assessment is one of the reliable techniques in assessing nutritional status, but it requires highly trained personnel and expensive tools.

### **3.4 Clinical Assessment**

This method is carried out by professional health care providers. The technique requires thorough examination from head to toe. The physical examination takes note of the texture of the hair, whether fluffy, thick, dark, reddish or brownish, (children). The skin is also checked whether luster, flaky, scaly, wrinkled, or flabby. Tongue and conjunctiva are checked for paleness.

### **3.5 Dietary survey:**

This method is carved out by dietary recall or record e.g 24 -hour recall, FFQ (Food Frequency Questionnaire) and Food Diary or Food intake Record. 24hr recall entails asking the individual to recall all that he or she has eaten within 24hrs. Food intake record, on the other hand is requesting the individual to record all that he or she eats or drink for a set period of time especially 2 to 7 days. FFQ is a list of variety of foods, and the consumer is asked to estimate the frequency with which they consume each item or food groups.

### **3.6 The Usefulness of Anthropometric Indices**

Of all the techniques of assessing the nutritional status of an individual anthropometric is the cheapest and the most frequently used to detect hidden or known non communicable chronic diseases (NCCDs). The usefulness of anthropometric technique includes the following:

Employing BMI technique, it gives possible on set of obesity among the adults by indicating overweight when the BMI is above 25 but less than 30. It helps to identify boys and girls that may be obese in adulthood. It helps to identify young boys and girls that may be underweight which

may lead to poor academic performance and low productivity. For boys, 2 to 20yrs, BMI less than 14.8 is classified as underweight, while that of girls is 14.4 of the same age group. A BMI within 18.4 to 19.2 for boys (2 to 20 years) and 18.0-19.0 for girls (2 to 20 years) is classified as overweight. Overweight leads to obesity and obesity is one of the main causes of non-communicable chronic diseases such as hypertension, stroke, diabetes and other heart diseases. The use of WHR that measures abdomen obesity has been associated with cardiovascular diseases, stroke, adult diabetes mellitus, forms of cancers, including colorectal, breast and prostate cancers. The risk of all these diseases increases in women when the WHR is above 0.8 and 1.0 for men.

The waist size is also an indicator of obesity. When the waist line for adult male is greater than 102cm and 88cm for adult female, it is classified as obesity.

#### **4.0 CONCLUSION**

In this unit you have understood the meaning of nutrition assessment and the four methods of assessing the nutritional status of an individual. In addition, you have learnt how to calculate BMI and WHI. The interpretations of these anthropometric data, should be known to you and you are ready to assess your own BMI and WHR and that of your family and friends. The anthropometric technique has also been described as the cheapest and easiest to apply to non communicable chronic diseases.

#### **5.0 SUMMARY**

This unit has described the various methods in assessing the nutritional status of an individual or a client. It has also shown that of the four methods, anthropometric technique has been singled out to be the cheapest and the mostly used to evaluate how well fed a person's nutrients are being met. The usefulness of anthropometric indices as predictors of non-communicable chronic diseases has also been illustrated in the text.

#### **6.0 TUTOR-MARKED ASSIGNMENTS**

1. What is the difference between BMI and WHR?
2. A client's anthropometric data are as follows, weight is 75kg, height is

1.75m, hip is 91cm, and waist is 94cm. based on the above calculate the

BMI and WHR.

## 7.0 REFERENCES/FURTHER READINGS

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## **UNIT 2    NUTRITION EDUCATION**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Definition of Nutrition Information and Nutrition Education
  - 3.2 Nutritional Counseling
  - 3.3 The goals of Nutrition education
  - 3.4 Methods of Disseminating Nutrition information
  - 3.5 Barriers to Effective Nutrition education
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/Further Reading

### **1.0 INTRODUCTION**

Since you have known how to assess the nutritional status of an individual especially, using anthropometric technique, you should have realized that there are some of your clients, friends or even family members that they may be underweight, overweight or obese. They need to be informed the hidden health problems for being in such condition. Nutrition education is the pivot to modifying or changing the nutritional habits that lead to any of the above nutritional status or any other form of nutritional deficiencies in the family or in the community. In this unit, you will learn some of the essential terms in nutrition education, methods of dissemination and evaluating nutrition education. Knowledge and skills in nutrition education become very essential when you begin to learn about nutritional care for some of the NCCDs in subsequent units.

### **2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- differentiate the following nutrition information, nutrition education and nutrition counseling
- identify at least three goals of nutrition education
- describe two methods each in disseminating nutrition information and nutrition education
- list three barriers to effective nutrition education.

### **3.0 MAIN CONTENT**

#### **3.1 Definitions in Nutrition Education**

There are three essential definitions in nutrition education that you should know. These are nutrition information, nutrition education and nutritional counseling.

Nutrition Information is the dissemination of nutritional knowledge on different types of foods, their values, and their usefulness to the body. Nutrition information is imparting of nutritional knowledge to the clients in an attempt to improve their nutritional status.

Nutritional Education can be defined as a positive change in dietary habits of an individual or that of a community. Nutrition information is a means to an end, not an end itself. Whereas, nutrition education is the outcome of effective information delivery. Nutrition education is all about seeing a positive change in nutritional behaviour of the client or the community,

3.2 Nutritional counseling is the process by which the client (patient) is actively and effectively helped by the nutritionist or a dietician on one on one to appropriate the significant role that adequate nutrition plays in healthy and in sickness.

Nutritional counseling serves two purposes. It helps the counselor to understand the nutritional felt and unfelt needs of the clients and also permits the clients to commit himself or herself to total care of the counselor on regular basis till remarkable change in dietary habits is observed.

#### **3.3 The goals of Nutrition Education**

The cardinal goal of nutrition education is to create community awareness as well as to facilitate the need for healthful nutritional practices. This goal can only be achieved if the community health worker first and foremost learn about the community by doing community diagnosis. This is important because such a diagnosis will reveal the major nutritional problem of the community and possible blocking factors. Other nutritional goals include:

Assisting the community to identify false nutritional advertisement. Encouraging the community or individual to eat foodstuffs that will promote, sustain and maintain quality health. Giving of nutrition information in the form of pamphlets, radio or television/short talks to

the community about the importance of adequate nutrition to total health.

- o Motivating the community to consider home gardening in order to reduce family food expenditure.
- o Motivating the community for nutrition action such as establishing a nutrition centres where mothers can come together for exchanging ideas about nutritional care for the growing infants.
- o Encourage the community to consider monitoring the patterns of weight gains by the infants, the adolescents and the elderly.

### **3.4 Methods of Disseminating Nutrition Information and Nutrition Education**

- The health worker has a choice of methods to be used in disseminating nutrition information or carrying out nutrition demonstration. It all depends on financial background, types of audience and the competence of the presenter.
- In situation where money is not a constraint, the mass media can be used for the two to inform the public at large about the right foodstuffs that make up an adequate diet.
- Other methods include:
  - Group Discussion: This method can be formal or informal as long as the Participants are aware of the nutritional problems at hand in the community.
  - Peer Nutrition Education: Peer to Peer nutrition education is very effective because both the presenters and learners are of equal rank. Free flow of information exists between them. The nutrition educator, however, has to train the presenters before he or she becomes peer nutrition
  - Role playing is another form of disseminating nutrition information. Through role playing or activity, nutrition messages can be delivered.

Story telling: Story telling on nutrition is another exciting and educative method but books on this is very scarce. Training of leaders in the Community: Training of church, mosque, market and traditional leaders on nutrition is also a vital tool because they have a wider audience.

Training of journalists, radio and television commentators.: The training of these special groups on nutrition issues will also help in disseminating nutrition information because they too have a wider audience.

Food demonstration: Of all the methods listed above, food demonstration is the most effective. The learners are exposed to practical food demonstration. Since nutrition education is to change people's nutritional behaviour. This can only be achieved if they see and practice what they should do later in their respective homes. After all, as the Chinese saying "What we hear – we forget  
"What we see – we remember

"What we do – we know"

Thus, you should not be satisfied with talking alone but include practical demonstration.

### **3.5 Barriers to Effective nutrition education**

Some of the barriers include:

Poor knowledge of the community: Prior to giving nutrition education, the educator must be familiar with general occupation of the people concerned, types of food crops grown, level of education, food preferences, food habits, food prices, current nutritional problems at the family or societal level.

Poor planning of nutrition education programme.

Poor communication skills at the community level: Lack of resources/human materials.

## **4.0 CONCLUSION**

Since you have learnt about nutrition information and nutrition education in this unit, you should be able to distinguish between the two terms. This unit has also dealt with the goals and various methods of nutrition education. Of all the methods of delivering nutrition education, food demonstration appears to be the most effective. Barriers to effective nutrition education have also been discussed.

## **5.0 SUMMARY**

This unit has described the uniqueness of nutrition education in the attainment of adequate nutrition. The differences between nutrition information and nutrition education has been illustrated. Methods of effective education and their barriers are also well discussed.

## 6.0 TUTOR-MARKED ASSIGNMENTS

1. What is the difference between nutrition education and nutrition information.
2. List three of the barriers to effective nutrition education

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## **UNIT 3 NUTRITIONAL CARE IN DISEASES**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Nutritional care in disease
  - 3.2 Aims of Diet Therapy
  - 3.3 Types of Diets
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/Further Readings

### **1.0 INTRODUCTION**

In the earlier units, we have learnt about the importance of food nutrients in the promotion of quality health of human beings. The needs of human body to maintain, sustain and promote well being include adequate intake of protein, carbohydrates, vitamins, minerals, fats and oils. In some cases where excess of some of these nutrients (protein, fats and carbohydrates) are taken, it may lead to some disease conditions. The use of diet in the treatment of these disease conditions is known as diet therapy or the use of diet in caring for disease condition. This unit is focusing on the use of diet in caring for some of the non communicable chronic disease conditions.

### **2.0 OBJECTIVES**

At the end of this unit, you should be able to:

- Discuss nutritional care in disease
- Explain how to use diet in the care and treatment of diseases
- Describe the different types of diets that could be used in the treatment of diseases

### **3.0 Main Content**

#### **3.1 Nutritional care in disease**

Nutrition cares are practices directed by health experts to assist patients to improve their dietary intake. Nutritionists and dietitians are expected to give nutrition care to patients for prevention and management of chronic and non-communicable diseases. The main aim of nutritional care is to improve nutritional behaviour and the general health status of

the patient.

Foods that a patient suffering from cardiovascular disease should take include: low fat fish e.g. tilapia, stock fish, lean meat, turkey/chicken without skin, snails and game (bush meat).

However, the patients should reduce the intake of fatty meat/fish such as hump (tozo), tongue, cow tail, skin, bacon sausage, hamburger, and mackerel.

Also, the intake of the following food items should be reduced for cardiovascular disease patients; refined (processed) foods such as semovita, corn-vita, baking flour, spaghetti, macaroni, noodles, etc. The patient should avoid organ meat like liver, kidney, brain, and intestine.

**Starchy foods which a diabetes mellitus patient should take include:**

Whole grain e.g. maize, millet, guinea corn, acha, roots/tubers e.g. water yam, Irish potatoes and unripe plantain.

Sugary foods the patients can take include: Fresh diluted fruit juices especially lemon/lime juice and unsweetened tea. Furthermore, they should also take green leafy vegetables with every meal. They should take fresh vegetable-based salads, squeeze-washed bitter leaves, vegetable soup, garden eggs, cucumber as snacks. The patients are also allowed to take soups thicken with any of the following soup thickeners: ukpo, achi, akparata, ofo, cowpea, pumpkin (kubewa) etc.

Conversely, a diabetes mellitus patient should reduce the intake of yam, cassava, (akpu, fufu), sweet potatoes, highly refined flour products such as semolina and cassava flour. Foods they should avoid are: sugarcane, honey, dates (dabino), sugar cane sweets (alewa), soft drinks, ice creams, lollypops, cocoa-based beverages, candies, sweets marmalades, jellies, chocolate bars and coffee if hypertensive. They should also avoid ripe plantain and banana.

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## **UNIT 4 NUTRITION CARE FOR PROTEIN-ENERGY MALNOURISHED CHILDREN**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Definition of Protein Energy Malnutrition (PEM)
  - 3.2 Diet for Protein Energy malnourished Children
  - 3.3 Features of Patterns of PEM
  - 3.4 The use of local fluid mixture for PEM
  - 3.5 The use of mixed diets for PEM
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/Further Readings

### **1.0 INTRODUCTION**

When diet is deficient in both protein and energy it is referred to as Protein Energy Malnutrition (PEM). This is a disease that is most common among the children. This unit aims at describing PEM and the use of locally available food sources in the management of the disease.

### **2.0 UNIT OBJECTIVES**

By the end of this unit, you will be able to:

define the term Protein Energy Malnutrition.

Describe the patterns of Protein Energy Malnutrition (PEM). Describe the prominent features of PEM

Plan a day menu for a protein energy malnourished child.

### **3.0 MAIN CONTENT**

#### **3.1 Definition of Protein Energy Malnutrition (PEM)**

PEM is defined as an umbrella word that covers a spectrum of nutritional deficiencies ranging from protein to energy due to undernutrition. The patterns of PEM are kwashiorkor, marasmus and marasmic-kwashiorkor. Kwashiorkor is due to lack of enough body building a food called protein that is required for strong muscles, blood and skin. They usually have oedema, moon face and look miserable.



Marasmus is the term given to those children who do not have enough food of any kind.

Those children are usually looking anxious and hungry. Marasmic-kwashiorkor children are those that have both signs of kwashiorkor and marasmus. Undernourished children are those that are just beginning to show signs on kwashiorkor on marasmus. Their body weights are usually greater than that of other patterns of PEM, but still below the normal standard weight.

### 3.2 Diet for protein energy malnourished children.

Prior to learning about dietary treatment for PEM, it is important to define the term PEM, and to understand the prominent features of PEM.

### 3.3 Features or Patterns of PEM

Prominent features of pattern of PEM is shown in the table below:

**Table 3.3: Prominent Features PEM\***

	Marasmus	Kwashiorkor	Marasmic kwashiorkor	Undernutrition
A.Age	1-2years	1-4years	1-4years	1-4years
B.Essential features				
Oedema	-	+++	+	-
Severe weight loss	+++	+	+	-
Muscle	+++	+	+	-
Enlarged fatty liver	-	+++	+	-
Severely dehydrated	+++	-	+	-
Anorexia	-	++	+	-
Growth retardation	+++	++	++	+

Skin changes	+++	++	+	Often
Hair changes	++	+++	+	Often
Apathy	+	++	+	-

\*Sources: Jellife, W.B., WHO monographs series No.53 and Whitney et al., 1998, pp.200

Key: +++=very prominent

++=prominent

=present

-=not present

### 3.4 The use of local fluid mixture for PEM

Usually, there is a loss of appetite among the children suffering from PEM particularly during the early management of PEM. Kwashiorkor and marasmic-kwashiorkor need to be given enough energy intake of 58.3kcal/kg/day before they start to lose oedema fluid. The recipes for local fluid mixtures are powdered full cream milk (23kg), vegetable oil (50g), pure cane sugar (50g), corn pap (750g). Mix all ingredients well and make up to 1 litre with previously boiled and cooled water. The full-cream powdered milk can be replaced with any available protein source- egg, groundnut paste/powder, crayfish or fish powder or soybean milk.

### 3.5 The use of Mixed diets for PEM

Evidence abounds in the literature that malnourished children that are over seven months and above can be effectively managed on local available complementary protein based diets. The recipes of these complementary proteins are: Breakfast: corn pap/guinea pap/wheat pap with akara (seasoned and fried bean balls) or moi-moi (steamed bean pudding). The contents of them include any of the grains, black eyed beans, pepper, onion, crayfish, palm-oil, salt, snack- mashed boiled yam, with palm oil, crayfish and a piece of banana.

Lunch: Rice with beans. The contents of the meal include rice, beans, pepper, onion, fresh tomatoes paste, palm oil, salt, crayfish.

Dinner: Eko (Agidi), beans, with vegetable soup. The contents of the meal include fermented corn flour, crayfish, smashed beans, fresh tomatoes, onion, palm oil, dried leafy vegetables.

#### **4.0 CONCLUSION**

In this unit, PEM has been defined and described as one of the most common childhood diseases. The patterns of PEM together with the prominent features have also been discussed. By now you should be able to distinguish between a marasmic and kwashiorkor child. The use of locally available nutrition foodstuffs in the management of PEM has also been explained.

#### **5.0 SUMMARY**

In this unit, the use of diet in the caring for protein energy malnourished children has been described. Definition and prominent features of PEM have also been described. The unit ends with specific locally available foodstuffs for the management of the disease.

#### **6.0 TUTOR-MARKED ASSIGNMENT**

- 1 (a). Define Protein- Energy Malnutrition (PEM).  
(b). What are the Patterns of PEM?
2. What are the features of marasmic patient?

#### **7.0 REFERENCES/FURTHER READINGS**

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## **UNIT 5      NUTRITIONAL CARE FOR HYPERTENSION PATIENT**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Definition of Hypertension and Types
  - 3.2 Major risk factors of hypertension
  - 3.3 Dietary treatment for Hypertension
  - 3.4 Aims of nutritional support for hypertensive patient
  - 3.5 Principles for selection and meal planning for hypertensive patient
  - 3.6. Definition, Classification of Diabetes and Warning Signs of type II Diabetes
  - 3.7 Predisposing factors for diabetes Type II
  - 3.8 Diet and diabetes
  - 3.9 Dietary strategies, Nutritional Therapy and Recommended nutritional plan for Diabetic Adult
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/Further Readings

### **1.0 INTRODUCTION**

Cardiovascular disease, such as hypertension has been classified as one of the leading causes of death in both developed and developing countries world over. In fact, hypertension has been described as a silent killer because it gradually increases the severity of heart attack without the patient having obvious signs of the discussed.

In this unit, the definitions of hypertension, its risk factors, types, aims of nutritional support for a hypertensive patient and principles for selection of meal planning will be discussed.

Furthermore, this unit will discuss diabetes mellitus. Diabetes mellitus is the most endocrine disease that is rapidly increasing in developing countries, especially in Nigeria. It is one of the most serious public health problems because of its morbidity and complications. Diabetes can also be described as results from a problem with the way the body handles the end product of carbohydrates (glucose). The hormone, called, insulin helps the body to enter glucose into the cells that make up

the organs and muscles. This hormone is produced by the pancreas, a gland that lies behind the stomach. When the level of glucose in the blood stream builds up, passes through the kidney and spills into the urine, diabetes is observed. This disease is usually noticed usually at the beginning of middle age in childhood or adolescence.

In this unit, you will also learn about types of diabetes, diets and diabetes and strategies for the control of type II diabetes. The role of diet in the causation, treatment and prevention of diabetes will be examined at the household level. Thus, definition of the disease and its classification will also be explained.

## **2.0 OBJECTIVE**

- By the end of this unit, you will be able to: Define hypertension in your own words.
- Differentiate between mild and moderate hypertension.
- List at least three risk factors for hypertension
- Describe two aims of nutritional support for a hypertensive patient.
- Identify two of the principles for planning a meal for hypertensive patient.

By the end of this unit, you will be able to:

- o Define diabetes and classify the disease.
- o Differentiate between insulin – dependent (Type I) and non insulin- dependent (Type II) diabetes,
- o List at least three warning signs of diabetes. Identify predisposing factors for diabetes.
- o List at least two goals of nutritional therapy for diabetes.
- o Describe at least three strategies for the two main types of diabetes.
- o Describe the recommended nutritional plan for adult diabetes.

## **3.0 MAIN CONTENT**

### **3.1 Definition of Hypertension**

Taber's cyclopedia medical Dictionary, defines hypertension as “a condition in which the patient has a higher blood pressure than judged to be normal”. In general when the systolic pressure is above 140mm of mercury or the diastolic is above 90mm, such a person can be considered as a hypertensive patient.

Hypertension can be grouped under two headings: essential and malignant hypertension. Essential hypertension or high blood pressure is developed without apparent causes. The other name to describe it is primary hypertension. Malignant hypertension is not common like the essential one. It usually occurs more in younger individuals and it is characterized by extreme elevations of blood pressure, blurring of vision and headache.

Hypertensive patients can also be classified as mild, moderate and severe hypertension depending on the blood pressure readings. Mild hypertensive patients are those whose readings are 140/90. Moderate individuals are those whose reading are between 140 to 180 systolic a 90/100 diastolic. Severe hypertension patients are those above 180 systolic and 100 diastolic.

### **3.2 MAJOR RISK FACTORS OF HYPERTENSION**

The major risk factors for hypertension are genetic factors, obesity, high sodium intake, alcohol, smoking, stress, and diet.

Of all the risk factors in the essential hypertension, dietary habit is very important because it is this dietary habit that if modified shall lead to reduction of weight gain, and salt intake. Both reduction in weight and salt intake will significantly reduce blood pressure elevation.

For parents with family history of essential hypertension, there is a fifty percent probability that their off springs may develop the disease.

Excessive salt or sodium chloride intake is another risk factor for hypertension. Interestingly, foodstuffs that are high in sodium are low in potassium. A low intake of potassium has also been reported to increase the risk of this disease.

Smoking and alcohol are also risk factors for hypertension. Smoking increases the risk of unpleasant long term outcomes of hypertension, heart attack and stroke. Moderate regular intake of alcohol has also been reported to raise the blood pressure.

Stress is another vital risk factors that may elevate blood pressure. Regular and uncontrolled stress in the form of physical and mental activities needs to be regarded as an important issue in the treatment of hypertension.

### 3.3 Dietary Treatment for Hypertensive Patient

The main subject is diet in the treatment of hypertension. The definition of and types of hypertension, its major risk factors together with the aims of nutritional support should be understood before diet prescription for the patient.

### 3.4 Aims of nutritional support for hypertensive patients.

The following are the aims of nutritional support for hypertensive patients:

Maintaining of an ideal body weight; achieving an appropriate sodium/potassium ratio in body fluids through dietary restrictions and/or supplementations; educating the patient on the role of non-drug therapies, such as weight control, sodium restriction, potassium, “supplementation” and reduction of alcohol intake in the maintenance of a “healthy” blood pressure.

### 3.5 Principles of selection and meal planning for hypertension patients.

One of the main principles for meal planning for hypertensive patient is the restriction of salt or sodium chloride. This reduction can be grouped according to the degree of hypertension, mild, moderate and severe. Those with mild hypertension should restrict their sodium to 2g/day; moderate and severe should restrict theirs to 1g/day and 0.5g/day respectively.

#### **Strategies to cut down salt intake include:**

Prepare food with sodium free spices such as curry, garlic, ginger, thyme. Cooking with small amount of added salt.

Avoiding salt at the table .

Read food labels with particular reference to salt quantity.

Foods that should be prescribed or used with caution because of high sodium content. These foodstuffs include:

Starch/bread list: Ready-to-eat cereals, bread, cream crackers, snack chips, baked beans, and canned vegetables with salt, biscuits, cakes, salted pop corn,

Meat list: Dried salted codfish and other salted meat or fish (sardine), smoked fish.

Vegetable list: All canned vegetables unless canned without salt.

Fruit list: All fruits canned in saline.

Milk list: Ice cream, milk shakes.

Fat list: salted butter and margarine, roasted and salted nuts and salad dressing

Other food item is tomato ketchup.

An example of a day's meal controlled for sodium, protein, phosphorous, potassium is taken from Smith and Ojofeitimi 1995. Breakfast. Thick corn pap 4 tsp salt free

Moinmoin (with ¼ tsp sugar, ½ tsp of oil) Lunch: Eba (Dough from garri) 4 tsp with okro soup (1/2 tbs) meat (100z) palm oil, 100z pineapple.

Dinner: Plain boiled rice (4 tsp) stew (onion ¼ tbs, fresh tomato

¼ tbs vegetable oil 100z. This sample menu provides more potassium (2347.6mg) than sodium (105.55mg). The sodium has been very restricted even less than 115 milligrams minimum requirements. This calculation is based on the use of food composition table in nutrition text books.

### **3.6 Definition, Classification of Diabetes and Warning Signs of type II Diabetes**

#### **Definition of Diabetes**

Diabetes is defined as a disorder of carbohydrate metabolism characterized by hyperglycemia (excess glucose in the blood) and glucosuria (sugar in the urine) that result as an inadequate production or utilization of insulin.

#### **Classification of Diabetes**

Majorly, there are two types of diabetes: Insulin-dependent diabetes mellitus (IDDM) and Non-Insulin dependent mellitus (NIDDM). The IDDM is now known as Type 1 diabetes which is attributed to either destruction or reduction in number of beta cells. This results to lack of insulin or inadequate insulin to control blood glucose. This type of diabetes occurs at any age but mostly among children. It is usually diagnosed before the age of 20 years. The NIDDM or Type 2 usually occurs after 40 years of age. This type 2, is usually due to inadequate supply of insulin or the insulin receptor response is decreased. The net result is hyperglycemia and glucosuria.



## **Warning signs of Type II Diabetes**

There are some vital signs that will occur to suggest the development of this disease before apparent symptoms appear. These include:

- ? individuals with family history of diabetes ;
- ? individuals with obstetrical history of overweight babies or with repeated still births or miscarriages
- ? individuals with spontaneous hypoglycemia that result to weakness, marked perspiration and fainting.

The main symptoms of Type II diabetes are increase in thirst, constant hunger, frequent urination, loss of weight, itching around the genital area, marked fatigue, changes in vision and slow healing of cuts and scratches.

### **3.7 Predisposing factors for Diabetes Type II**

The predisposing factors for Type 2 diabetes are family history of diabetes, excess weight (being overweight appears to increase the body's demand for insulin), age (the chances of developing the disease increase with age), gender (women are more likely to get the disease than men after the age of 30 and between the ages of 45 and 65) and inactivity. This is because from 45 years and above, levels of activities decrease and sedentary life styles become prominent especially after the age of 60 years. Sedentary lifestyles are more likely to develop the disease because physical in activities seem to make the available insulin work lesser.

### **3.8 Diet and Diabetes**

Diet is the keystone of treatment, especially type 2 diabetes mellitus. There is no specific 'diabetic diet', in controlling diabetes. The diet depends on individual. An overweight or obese individual that has been diagnosed as type 2 diabetic patient, the emphasis should be placed on weight loss. The plan for dietary intake will include reduction of certain nutrients such as carbohydrates and fats in such a way that the individual lose weight and yet still having adequate diet. The aim of such a diet is to help the body make better use of carbohydrates. Such diet should be low in fats, especially saturated fats (palmitic and stearic acids from animal proteins).

Planning a diet for diabetic patient depends on number of factors that include;

- The level of sugar in the blood
- The need to lose weight and how much;
- The level of insulin available;
- The age, the level of activities, and overall health status.

### The Goals for nutritional therapy of diabetes

The specific goals for nutritional therapy of diabetes include:

- ? The achievement of physiologic blood glucose level; The maintenance of desirable plasma lipids.
- ? Reduction of body weight for obese persons with NIDDM and maintenance of an acceptable body weight.
- ? Reduction of possibility of diabetes complications such as retinopathy (disorder of the retina), nephropathy (disease of the kidney), and neuropathy (disease of the nerves).
- ? The retardation of the development of atherosclerosis (degeneration of blood vessels caused by a deposit of fatty materials along the lining of the wall of a blood vessel).
- ? Establishing and maintaining consistent meal timing. Improvement in overall health.

### 3.9 Dietary strategies for the two main types of diabetes

Dietary strategy	Obese patients who do not require insulin	Insulin-dependent none obese patients
(i).Decrease calorie	Yes	No
(ii).Protector improve Beta-cell function	Very urgent Priority	Seldom Important
(iii).Day to day consistency in intakes of calories, carbohydrates, protein, and fat	Not crucial, average caloric intake is kept low	Very important
(iv).Day to day consistency in ratios of carbohydrates, protein and fat for each feeding	Not crucial	Desirable
(v).Consistency in meal planning	Not crucial	Very important
(vi).Extra food for unusual exercise	Not usually appropriate	Usually appropriate
(vii).Use of food to treat, abort or Prevent hypoglycemia	Not necessary	Important

(viii).During complicating illness, Provides mall frequent feedingIV Carbohydrate to prevent	Often not necessary because Of resistance to ketosis	Important.
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Source: Smith, I.F. and Ojofeitimi, E.O.(1995)

**Recommended Nutritional Plan for Adult Diabetic Patients**

AsdiscussedinUnit3.8,dietisanindispensabletreatmentoftype2diabetes worldwide. The diets being used are those developed and prescribed by the American Diabetes Association(ADA).There commended nutritional plan is described below:

Table37a..Nutritional Recommendations for TypeII Diabetes Patients\*

Component	Recommendations of Diabetes Association
Carbohydrate(CHO)	55-60%,UnrefinedCHOemphasized
Protein	12-20%, Adult Recommended daily Allowance
Fat	Lessthan30%
Cholesterol	Lessthan300mg/day
Fiber	Lessthan25g/1000caloriesmaximumof50g/day

Source: American Diabetic Association and American Diabetic Association:HealthyFoodsChoices.Chicago,1980.

It should be noted from the above table that the diet should be adequate not only in carbohydrates, proteins and fats but also vitamins. It is also important to note that if the individual is overweight or obese,weight loss is essential and this plan guarantee weight loss. The table should be used with information given in unit 3.9

**4.0 CONCLUSION**

In this unit, you have learnt about hypertension, its definition, types And predisposing factors. The aims of nutritional support or hypertensive patients have also been highlighted. The principles of meal planning for hypertensive patient has also been discussed with major emphasis on salt restriction and ensuring intake of food stuffs rich in potassium. An example of a salt restricted

meal has also been shown in this unit. The sample menu gives a total 105.55mg of salt and 2347.6mg of potassium.

The unit has further exposed us to the importance of diet in the management of the two main types of diabetes. It has defined and classified diabetes accordingly. The warning signs of diabetes have been described and also predisposing factors as to the causation of the disease have explained. Both the goals for nutritional therapy of diabetes and dietary strategies have been discussed. Finally, recommended nutritional plan for adult diabetic patients according to American Association of Diabetes has been presented as guideline to prepare diets for adult diabetic patients.

## 5.0 SUMMARY

In this unit, the nutritional care for hypertensive patients has been discussed. The types of hypertension and its grouping have also been explained. The risk factors for hypertension and aims of nutritional care for the disease were also listed. A sample of a meal plan for a hypertensive patient has also been discussed and analysed for salt and potassium.

The unit has taught that diabetes as a major health problem in both young ones and adults. The incidence of the disease continues to increase in Nigeria and has its major management in the application of dietary knowledge in the maintenance of blood glucose and regular monitoring of weight. The major concern about the disease is the prevention of its health complication. Nutritional recommended plan has been provided as guidelines to plan diet for adult patients.

## 6.0 TUTOR-MARKED ASSIGNMENT

- 1a. With specific examples, differentiate between mild and moderate hypertension.
- b. Describe two aims of nutritional support for a hypertensive patient.
- 2a. What are the differences between Type I and Type II diabetes mellitus?
- b. Describe the nutritional recommended plan for adult diabetic patients in your own words.

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## **MODULE 5            NUTRITIONAL GENOMICS**

Unit 1	Concept of Nutrigenomics.
Unit 2	Rationale for Nutrigenomics
Unit 3	Genetic Variations
Unit 4	Bioactive Food Component and Dietary fat
Unit 5	Nutrigenomics in relation to Nutrigenetics

### **UNIT 1        CONCEPT OF NUTRIGENOMICS.**

#### **CONTENTS**

1.0	Introduction
2.0	Objectives
3.0	Main Content
	3.1    N u t r i g e n o m i c s
	3.2    Definition of concept
	3.3    E l e m e n t s   o f   N u t r i g e n o m i c s
4.0	Conclusion
5.0	Summary
6.0	Tutor-Marked Assignments
7.0	References/Further Readings

#### **1.0        INTRODUCTION**

Nutrition and genetics both play an important role in human health as well as the development of chronic diseases such as cancer, osteoporosis, diabetes and cardiovascular disease. Nutrigenomics is the study of response of humans to food and food components. It is the study of how individual genetic makeup interacts with diet, especially the effects of this interaction on a person's health. Nutrigenomics will be used to determine the role of diet in causing disease in relation to certain genes. On the other hand Nutrigenetics is the branch of science concerned with the effect of heredity on diet and nutrition.

#### **2.0        UNIT OBJECTIVES:**

By the end of this unit, you will be able to:

- Define nutrigenomics and nutrigenetics
- Identify the elements of nutrigenomics

### 3.0 MAIN CONTENT

#### 3.1 Nutrigenomics

Nutrigenomics or nutritional genomics, is a multidisciplinary science that combines information from genetics, nutrition, physiology, pathology, molecular biology, bioinformatics, bio-computation, sociology, ethics, and other disciplines. We believe that understanding diet - nutrient interactions in different individuals will help explain and help alleviate health disparities - hence, this knowledge applies to national and international societal issues in personal and public health. **The promise of nutritional genomics is personalized medicine and health** based upon an understanding of our nutritional needs, nutritional and health status, and our genotype. Nutrigenomics will also have impacts on society "from medicine to agricultural and dietary practices to social and public policies" and its applications are likely to exceed that of even the human genome project. Chronic diseases (and some types of cancer) may be preventable, or at least delayed, by balanced, sensible diets. Knowledge gained from comparing diet/gene interactions in different populations may provide information needed to address the larger problem of global malnutrition and disease.

#### 3.2 Definition of concept

Nutrigenomic is both examination of how nutrients affect genes (i.e influence gene expression and function) and how genes affect diet (what an individual eats and how an individual responds to nutrients), with the latter sometimes being referred to as nutrigenetics. Nutrigenomic describes the scientific approach that integrates nutritional science and genomics and also include the application of other high-throughput "omic" technologies such as transcriptomics, proteomics, and metabolomics to investigate the effects of nutrition on health.

Genomics is the new science that deals with the discovery and noting of all the sequences in the entire genome of a particular organism. The genome can be defined as the complete set of genes inside a cell. Genomics is, therefore, the study of genome of organisms. Determining the genomic sequence, however, is only the beginning of genomics. Once this is done, the genomic sequence is used to study the function of the numerous genes (functional genomics), to compare the genes in one organism with those of another (comparative genomics), or to generate the 3-D structure of one or more proteins from each protein family, thus offering clues to their function (structural genomics).

Genomics is an entry point for looking at the other 'omics' sciences. The information in the genes of an organism, its genotype, is largely responsible for the final physical makeup of the organism, referred to as

the “phenotype”. However, the environment also has some influence on the phenotype. DNA in the genome is only one aspect of the complex mechanism that keeps an organism running – so decoding the DNA is one step towards understanding the process. However, by itself, it does not specify everything that happens within the organism. The basic flow of genetic information in a cell is as follows. The DNA is transcribed or copied into a form known as “RNA”. The complete set of RNA (also known as its transcriptome) is subject to some editing (cutting and pasting) to become messenger-RNA, which carries information to the ribosome, the protein factory of the cell, which then translates the message into protein.

### **Proteomics**

Proteins are responsible for an endless number of tasks within the cell. The complete set of proteins in a cell can be referred to as its proteome and the study of protein structure and function and what every protein in the cell is doing is known as proteomics. The proteome is highly dynamic and it changes from time to time in response to different environmental stimuli. The goal of proteomics is to understand how the structure and function of proteins allow them to do what they do, what they interact with, and how they contribute to life processes.

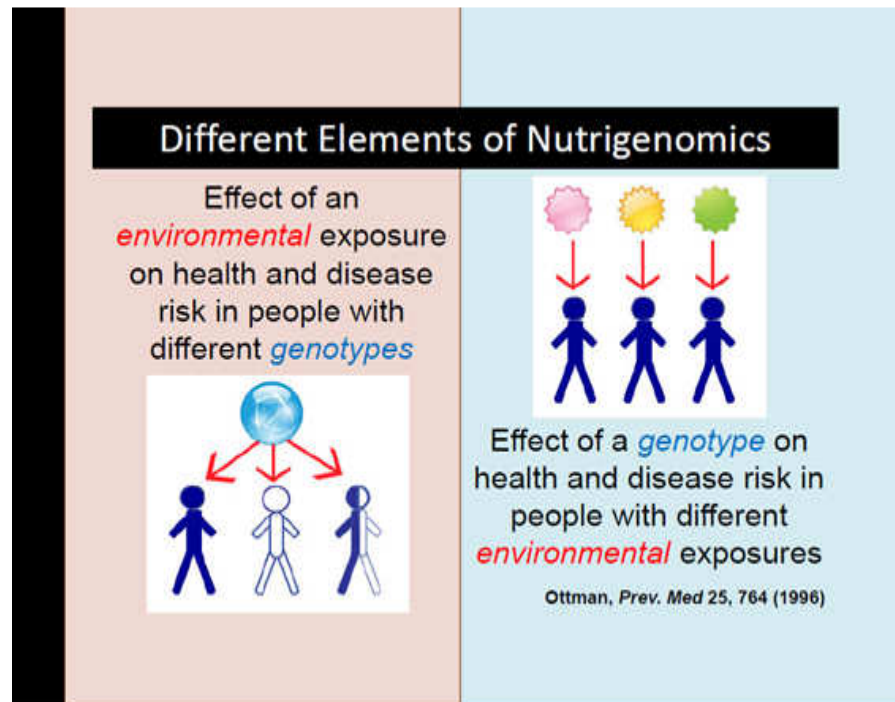
### **Metabolomics**

Metabolomics is one of the newest ‘omics’ sciences. The metabolome refers to the complete set of low molecular weight compounds in a sample. These compounds are the substrates and by-products of enzymatic reactions and have a direct effect on the phenotype of the cell. Thus, metabolomics aims at determining a sample’s profile of these compounds at a specified time under specific environmental conditions. Genomics and proteomics have provided extensive information regarding the genotype but convey limited information about phenotype. Low molecular weight compounds are the closest link to phenotype.



### 3.3 Elements of Nutrigenomics

#### Different Elements of Nutrigenomics



### 4.0 CONCLUSION

In this unit , we have discussed Nutritional genomic, the concept of nutrigenomics and nutrigenetics. In addition to describing the scientific approach that integrates nutritional sciences and genomics, we have also looked at the inclusions of nutrigenomics which is the application of other high-throughput ‘omics’ technologies such as transcriptomic, proteomics and metabolomics to investigate the effect of nutrition on health. We have also discussed the role of nutrition and genetics in human health and in the development of diseases such as cancers, cardiovascular diseases, diabetes and etc. Different elements of nutrigenomics has been displayed in this unit. Nutritional genomic is a rapidly emerging science still in its beginning stages.

### 5.0 SUMMARY

Nutrigenomics has been defined as the application of high-throughput genomic tools in nutrition studies and research. It can also be seen as research to provide people with methods and tools who are looking for disease preventing and health promoting foods that match their lifestyles, cultures and genetics. Genomics provides an overview of the complete set of genetic instructions provided by the DNA, while transcriptomics looks into gene expression patterns. Proteomics studies

dynamic protein products and their interactions, while metabolomics is also an intermediate step in understanding organism's entire metabolism.

## 6.0 TUTOR-MARKED ASSIGNMENTS

1. Explain the term nutrigenomics
2. What are the Different Elements of Nutrigenomics

## 7.0 REFERENCES/FURTHER READING

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**UNIT 2          RATIONALE FOR NUTRIGENOMICS****CONTENT**

- 1.0 Introduction
- 2.0 Unit Objectives
- 3.0 Main Content
  - 3.1 Why Nutrigenomics?
  - 3.2 The Process of Nutrigenomics
  - 3.3 Examples of Nutrigenomics
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/further Reading

**1.0 INTRODUCTION**

Dietary intake of a nutrient does not necessarily result in the same concentrations in the blood or tissue because substantial individual variability can exist in the absorption, distribution, metabolism and elimination. We need to personalize our nutrition regimen based on individual genetic make-up, culture and environment.

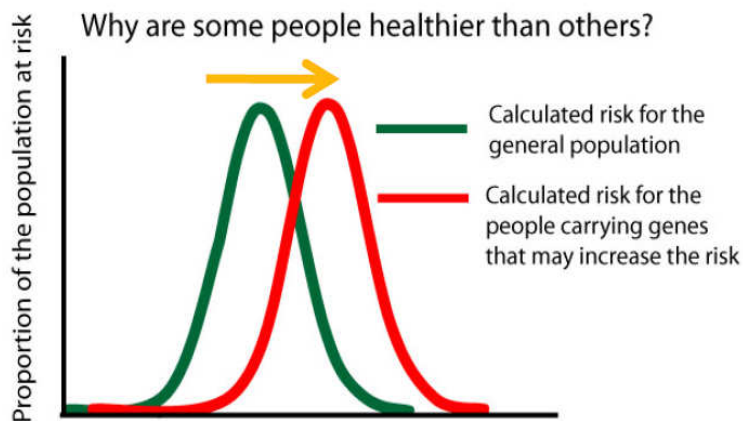
**2.0 OBJECTIVES**

By the end of this unit, you will be able to:

- Understand why some people are healthier than others.
- Estimate the potential risk of the general public
- Estimate the proportion of the population at risk

### 3.0 MAIN CONTENT

#### 3.1 Why Nutrigenomics



#### 3.2 The Process of Nutrigenomics

The mechanisms responsible for the between-person differences in dietary response are very complex and have been poorly understood. Research to date has indicated that diet-gene interactions play a significant role in this between-person variability, and has clarified some of these genetic differences. The interaction between genetic and dietary influences can result in a higher risk of disease in certain individuals and populations

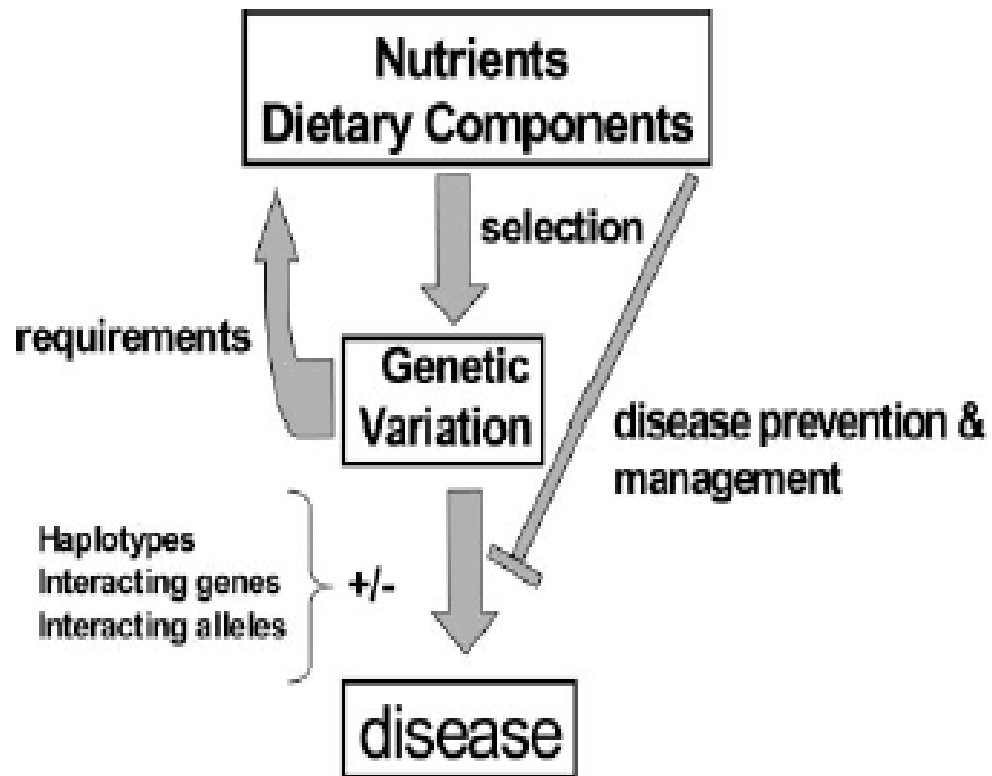


Fig. 1. Nutritional genomics. Research and discovery in nutritional genomics elucidate the reciprocal interactions among nutrients, metabolic intermediates, and the mammalian genome. Understanding the interrelationships among human genetic diversity, genome function, and dietary components will enable precise manipulation of genome function and stability throughout the life cycle for optimal human health and disease prevention.

### 3.3 Examples of Nutrigenomics

Although the term nutrigenomics is relatively new, the concept has been around for some time. Perhaps the most familiar example is lactose intolerance, which is a condition resulting from an inadequate production of lactase in the small intestine due to genetic variation in the lactase gene. Phenylketonuria (PKU) is an inborn error of metabolism, which represents another classic example of nutrigenomics. PKU can result from a genetic variation in phenylalanine hydroxylase (the enzyme needed to convert phenylalanine to tyrosine), which leads to a decrease in phenylalanine hydroxylase activity. Individuals with PKU can develop neurological damage (severe mental retardation and seizures) from excess phenylalanine.

#### 4.0 CONCLUSION

This unit has looked at the rationale of nutrigenomics, why some people are healthier than others, the process of nutrigenomics and examples of Nutrigenomics. It is also clear from this unit that understanding the interrelationships among human genetic diversity, genome function, and dietary components will enable precise manipulation of genome function and stability throughout the life cycle for optimal human health and disease prevention.

#### 5.0 SUMMARY

This unit has described the reason for the study of nutrigenomics and the processes of nutrigenomics have been clearly explained. Some individuals have genes that make them stay healthy and free from disease while some have genetic make-up that predispose them to chronic diseases.

#### 6.0 TUTOR-MARKED ASSIGNMENTS

1. Why are some people healthier than others?
2. With appropriate examples describe the mechanisms responsible for the between-person differences in dietary response.

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## UNIT3 GENETIC VARIATIONS

### CONTENTS

- 1.0 Introduction
- 2.0 Unit Objective
- 3.0 Main content
  - 3.1 Genotype and phenotype
  - 3.2 Genetic basis
  - 3.2 Fate and Activities of Nutrients in the Cell
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-marked assignments
- 7.0 References/Further Reading

### 1.0 INTRODUCTION

There are several different types of genetic variations, including single nucleotide polymorphisms (SNPs), which are alterations in a single nucleotide. The gene is the functional and physical unit of heredity passed from parent to offspring. **Genes** are segments of DNA that contain the information for making a specific protein. When variations in the DNA occur the result can be changes to the structure and function of the protein. **Alleles** are the variant forms of a gene at a particular location on a chromosome. The **genotype** is the genetic identity of an individual for a genetic site, determined from the combination of maternal and paternal alleles.

### 2.0 OBJECTIVES

At the end of this unit, students should be able to:

- Understand the concept of genetic variation
- Know when and how it occurs

### 3.0 MAIN CONTENT

#### 3.1 Genotype and phenotype

**Genotypes:** They do not necessarily show as outward characteristics, and as such are different from **phenotypes**.

A **phenotype** is an observable trait in an individual such as hair color, high blood sugar concentrations, or the presence of a disease'.

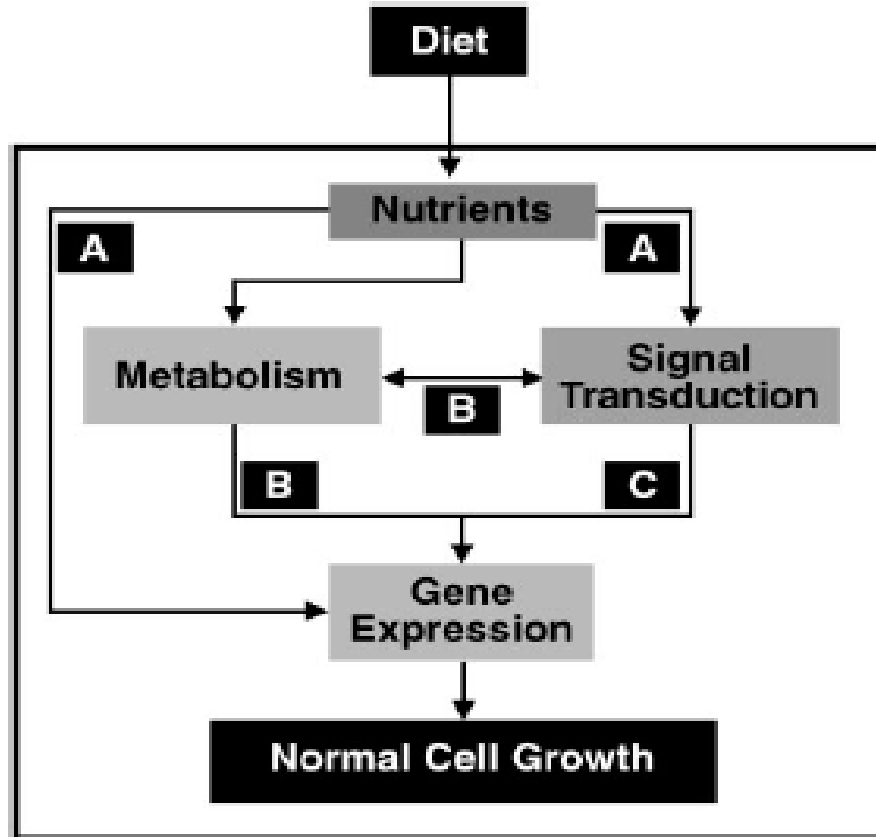
Individuals with the same **genotype** may have different **phenotypes**, in part, because of their different environments.



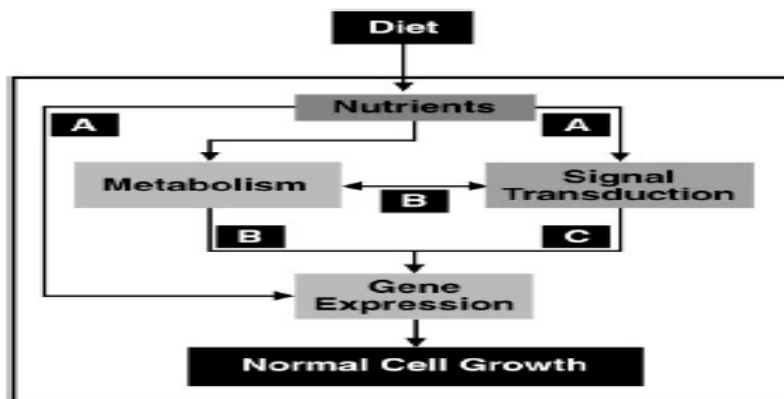
### 3.2 Genetical Basis

A haplotype is a group of alleles that are inherited together and, therefore, groups of genetic polymorphisms are often inherited together.

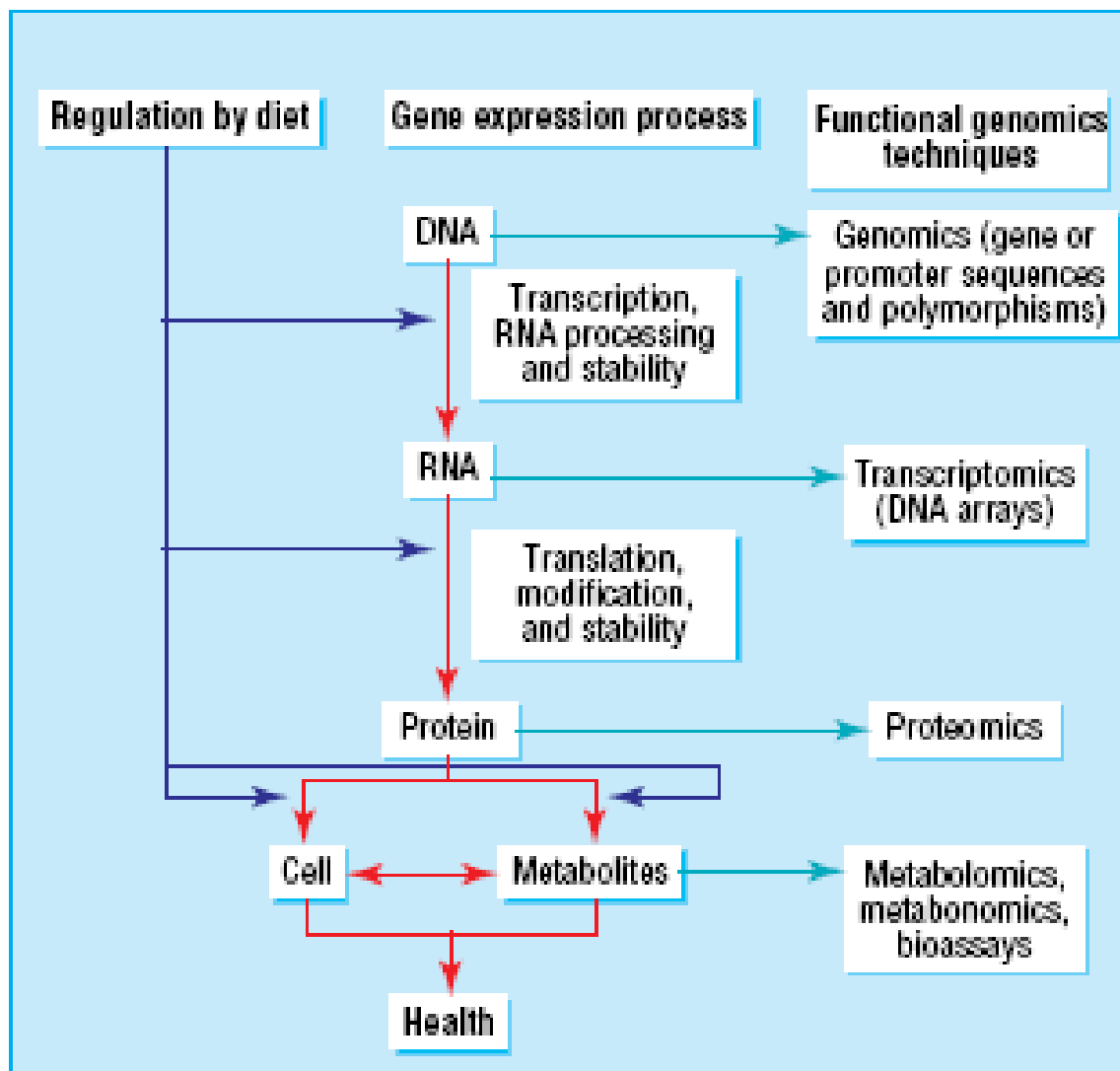
### 3.3 Fate and Activities of Nutrients in the Cell



May act directly as ligands for transcription factor receptors (pathway A)



May be metabolized by metabolic pathways ↓ altering concentrations of substrates/ intermediates (pathway B)



**Fig 1** Schematic representation of the steps involved in gene expression (centre), the stages at which diet can modulate these processes (left), and the functional genomics techniques used to analyse each stage (right)

### Examples

Incorporating data on genetic variability into a nutrition study can clarify whether or not a specific dietary compound is linked to a particular health outcome.

## 4.0 CONCLUSION

In this unit we have addressed genetic variation and the factors that can lead to these variations. We discussed the issue of genotype and phenotype. Genotype has been defined as the genetic identity of an individual for a genetic site, determined from the combination of

maternal and paternal alleles. Also the unit has explained the meaning of phenotype by describing it as is an observable trait in an individual such as hair colour, high blood sugar concentrations, or the presence of a disease'. The fate and activities of nutrient in the cell has been described.

## 5.0 SUMMARY

The study of nutritional genomic has provided a baseline information on the need for individual nutrition regimen and not generalized nutrition guideline. Incorporating data on genetic variability into a nutrition study can clarify whether or not a specific dietary compound is linked to a particular health outcome.

## 6.0 TUTOR-MARKED ASSIGNMENTS

1. Discuss the effect of genetic variation on health outcome
2. With the aid of diagrams, display the fate of nutrient in the cell

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## UNIT4      **BIOACTIVE FOOD COMPONENTS AND DIETARY FAT**

### CONTENTS

- 1.0 Introduction
- 2.0 Unit Objective
- 3.0 Main content
  - 3.1 Partial List of Bioactive Food Components
  - 3.2 Effects of Selenium on Certain Genes
  - 3.3 Alcohol, Alcohol Metabolism&Risk of Heart Disease
  - 3.4 Caffeine
  - 3.5 Circulating Lipids Risk Factor
  - 3.6 Familial Hypercholesterolaemia
  - 3.7 Symptoms &Diagnosis of Familial Hypercholesterolemia
  - 3.8 Gene and Familial Hypercholesterolemia
  - 3.9 Treatment For Familial Hypercholesterolemia
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-marked Assignment
- 7.0 References/Further Reading

### 1.0 INTRODUCTION

The aim of nutrigenomics also include being able to demonstrate the effects of bioactive food compounds on health and effects of health foods on health, which should lead to the development of functional foods that will keep people healthy according to their individual needs.

Bioactive food components can modify transcription, translation and metabolism.

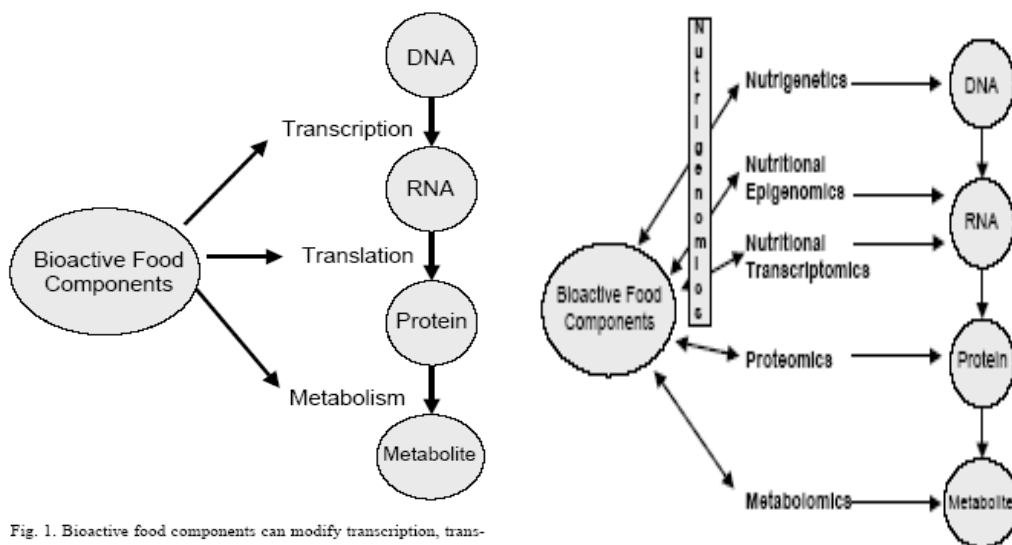


Fig. 1. Bioactive food components can modify transcription, translation and metabolism.

Furthermore, there is growing evidence that the optimal amount and type of dietary fat intake depends, in part, on an individual's unique genetic profile. For example, plasma omega 3 fatty acid response to an omega 3 fatty acid supplement was found to be modulated by apoE !4, but not by the common PPAR-! L162V polymorphism

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- Describe the bioactive food components
- The effects of these food components on human health
- Effects of alcohol on both slow and fast alcohol metabolizers
- The risk attached to intake of coffee/caffeine
- Identify the relationship between fatty acid and individual genetic composition
- Identify the genes that determine levels of circulating lipid risk factors
- Discover potential susceptibility genes.

## 3.0 MAIN CONTENT

### 3.1 Partial List of Bioactive Food Components: With Possible Effects on Cancer

*Partial list of bioactive food components that may influence cancer risk and tumor behavior*

Class	Bioactive component	Dietary source
Vitamins	Vitamin D	Dairy products
	Folic acid	Vegetables
	Vitamin A	Vegetables
	Vitamin E (-tocopherol)	Vegetable oils
	Ascorbic acid	Vegetables, fruits
Minerals	Calcium	Dairy products, vegetables
	Selenium	Cereal grains, meat, fish
	Zinc	Meat, vegetables
Carotenoids	Lycopene	Tomatoes
	Lutein	Dark green vegetables
Flavonoids	$\beta$ -Carotene	Orange-yellow vegetables
	Genistein	Soybeans, soy products
	Resveratrol	Grapes, red wine
	Quercetin	Vegetables, fruits
	Tangeretin	Citrus fruits
Organosulfur	Catechins	Grapes
	(-)-Epigallocatechin-3-gallate	Green tea
	Allyl sulfur	Allium vegetables
	Diallyl sulfide	Garlic
Isothiocyanates	Allyl isothiocyanate	Cabbage
	Benzyl isothiocyanate	Garden cress
Indoles	Sulforaphane	Broccoli
	Indole-3-carbinol	Cruciferous vegetables
Monoterpenes	D-Limonene	Citrus fruit oils
	D-Carvone	Caraway seed oil
Phenolic acids	Curcumin	Tumeric, curry, mustard
	Caffeic acid	Fruits, coffee beans, soybeans
	Ferulic acid	Fruits, soybeans
	Chlorogenic acid	Fruits, coffee beans, soybeans
Chlorophyll	Chlorophyll	Green vegetables
	Chlorophyllin	Green vegetables

Adapted from Huang, M.-T., Osawa, T., Ho, C.-T., & Rosen, R. T. (1994) Food Phytochemicals for Cancer Prevention I: Fruits and Vegetables. American Chemical Society, Washington, DC.

### 3.2 Effects of Selenium on Certain Genes

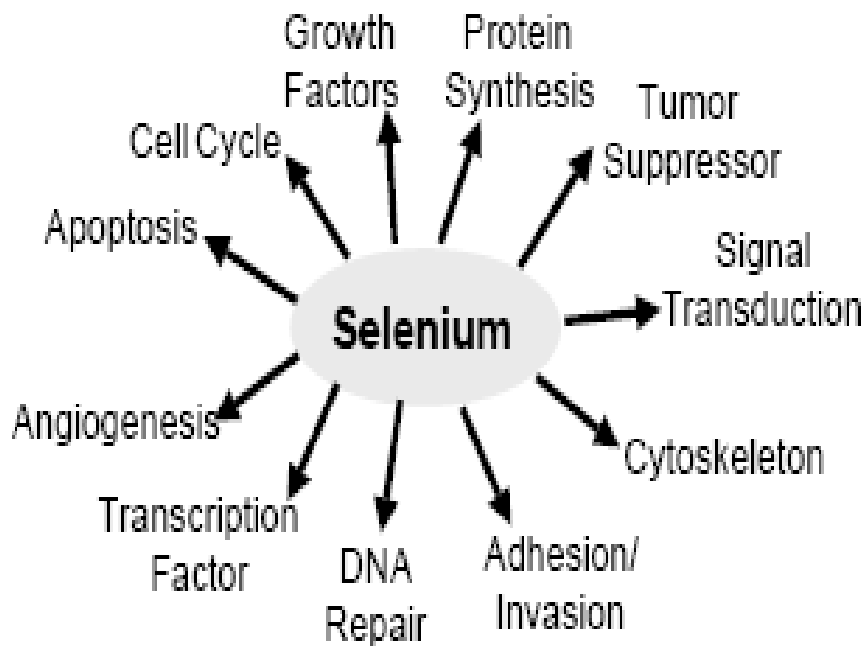


Fig. 3. Categories of genes that are mediated by dietary selenium in human prostate cancer cells as determined by microarray analysis. Data were obtained from Dong et al. [61].

### 3.3 Alcohol, Alcohol Metabolism & Risk of Heart Disease

Moderate alcohol consumption has been associated with a lower risk of heart disease. The enzyme alcohol dehydrogenase 1C (ADH1C), also known as alcohol dehydrogenase type 3 (ADH3) oxidizes alcohol to acetaldehyde. It has two polymorphic forms with distinct kinetic properties.

#### Alcohol Metabolism

It has two polymorphic forms with distinct kinetic properties. The ADH1C\*1 allele produces !1 and the ADH1C\*2 allele produces !2. The rate of alcohol metabolism (ethanol oxidation) in !1!1 individuals is more than twice as high as in !2!2 individuals, with individuals metabolizing alcohol at an intermediate rate.

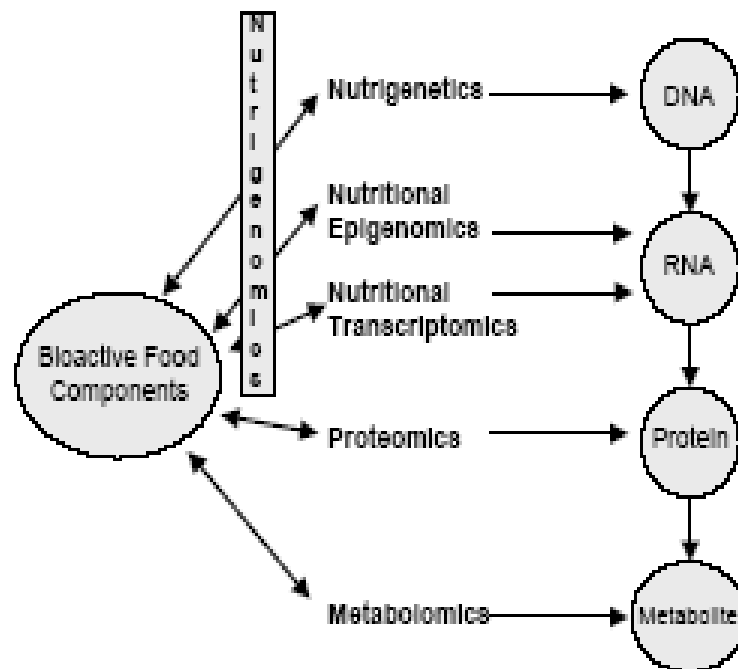
#### Alcohol & Risk of Heart Disease

Therefore, if there is a causal protective effect of moderate alcohol on risk of heart disease, this effect would be expected to be stronger in individuals with the slow ADH1C genotype compared to those with fast

metabolism.

### 3.4 Caffeine

Caffeine is metabolized primarily by the cytochrome P450 1A2 (CYP1A2) enzyme, and a polymorphism in the CYP1A2 gene determines whether individuals are rapid caffeine metabolizers (those who are homozygous for the -163 A allele) or 'slow' caffeine metabolizers (carriers of the -163 C allele). Intake of coffee is associated with an increased risk of MI (myocardial Infarction only among individuals with slow caffeine metabolism (Cornelis et al. 2006), suggesting that caffeine increases risk of MI since it is the only major compound in coffee that is known to be detoxified by CYP1A2.



### 3.5 Circulating lipids Risk Factors

The most heavily researched area is that concerned with genes that determine levels of circulating lipid risk factors – lipoproteins, LDL, HDL cholesterol triglycerides and lipoprotein particles. There are many potential susceptibility genes, particularly, for example, those concerned with producing the proteins involved with the metabolism of these particles. Others might involve the transport of these particles, or the structure and function of target sites.

### 3.6 Familial Hypercholesterolaemia

Familial hypercholesterolaemia (FH) is caused by a mutation in the LDL receptor that results in a catastrophic increase in LDL concentrations in

the blood and an increase risk of cardiovascular disease. Familial hypercholesterolemia is an inherited condition that causes high levels of LDL (low density lipoprotein) cholesterol levels beginning at birth, and heart attacks at an early age. Cholesterol is a fat-like substance that is found in the cells of the body. Cholesterol is also found in some foods. The body needs some cholesterol to work properly and uses cholesterol to make hormones, vitamin D, and substances that help with food digestion. However, if too much cholesterol is present in the blood stream, it builds up in the wall of the arteries and increases the risk of heart disease.

Cholesterol is carried in the blood stream in small packages called lipoproteins. These small packages are made up of fat (lipid) on the inside and proteins on the outside. There are two main kinds of lipoprotein that carry cholesterol throughout the body. These are: low density lipoprotein (LDL) and high density lipoprotein (HDL). The cholesterol carried by LDL is sometimes called the "bad cholesterol." People who have familial hypercholesterolemia have high levels of LDL cholesterol because they cannot remove the LDL from the blood stream properly. The organ responsible for the removal of the LDL is the liver. High levels of LDL cholesterol in the blood increase the risk for heart attacks and heart disease.

The cholesterol carried by HDL is sometimes called the "good cholesterol." HDL carries cholesterol from other parts of the body to the liver. The liver removes cholesterol from the body. Higher levels of HDL cholesterol lower a person's chance for getting heart disease.

Men who have familial hypercholesterolemia have heart attacks in their 40's to 50's, and 85 percent of men with the disorder have a heart attack by age 60. Women who have familial hypercholesterolemia also have an increased risk for heart attack, but it happens 10 years later than in men (so in their 50's and 60's).

Familial hypercholesterolemia is inherited in families in an autosomal dominant manner. In autosomal dominant inherited conditions, a parent who carries an altered gene that causes the condition has a 1 in 2 (50 percent) chance to pass on that altered gene to each of his or her children. The altered gene (gene mutation) that causes familial hypercholesterolemia is located on chromosome number 19. It contains the information for a protein called LDL receptor that is responsible to clear up LDL from the blood stream. One in 500 individuals carries one altered gene causing familial hypercholesterolemia. These individuals are called heterozygotes. More rarely, a person inherits the gene mutation from both parents, making them genetically homozygous. Individuals who are homozygous have a much more severe form of



hypercholesterolemia, with heart attack and death often occurring before age 30.

### **3.7 Symptoms and Diagnosis of Familial Hypercholesterolemia**

#### Symptoms of Familial Hypercholesterolemia

The major symptoms and signs of familial hypercholesterolemia are:

- High levels of total cholesterol and LDL cholesterol.
- A strong family history of high levels of total and LDL cholesterol and/or early heart attack.
- Elevated and therapy-resistant levels of LDL in either or both parents.
- Xanthomas (waxy deposits of cholesterol in the skin or tendons).
- Xanthelasmas (cholesterol deposits in the eyelids).
- Corneal arcus (cholesterol deposit around the cornea of the eye).
- If angina (chest pain) is present, it may be sign that heart disease is present.
- 

Individuals who have homozygous familial hypercholesterolemia develop xanthomas beneath the skin over their elbows, knees and buttocks as well as in the tendons at a very early age, sometime in infancy. Heart attacks and death may occur before 30.

#### Diagnosis of Hypercholesterolemia

Diagnosis of familial hypercholesterolemia is based on physical examination and laboratory testing. Physical examination may find xanthomas and xanthelasmas (skin lesions caused by cholesterol rich lipoprotein deposits), and cholesterol deposits in the eye called corneal arcus. Laboratory testing includes blood testing of cholesterol levels, studies of heart function, and genetic testing. Blood testing of cholesterol levels may show: increased total cholesterol usually above 300 mg/dl (total cholesterol of more than 250 mg/dl in children) and LDL levels usually above 200 mg/dl. Studies of heart function, such as a stress test, may be abnormal. Genetic testing may show an alteration (mutation) in the LDL receptor gene.

### **3.8. Gene and Familial Hypercholesterolemia**

Familial hypercholesterolemia is inherited in an autosomal dominant manner. This means that to have this condition, it is sufficient that the altered (mutated) gene is present on only one of the person's two number 19 chromosomes. A person who inherits one copy of the gene mutation

causing familial hypercholesterolemia from one of his/her parents is said to have heterozygous familial hypercholesterolemia. This person has a 1 in 2 (50 percent) chance to pass on the mutated gene to each of his/her children. A person who inherits a mutated copy of the gene causing familial hypercholesterolemia from both parents is said to have homozygous familial hypercholesterolemia. This is a much more severe form of familial hypercholesterolemia than heterozygous familial hypercholesterolemia. Each of this person's children will inherit one copy of the mutated gene and will have heterozygous familial hypercholesterolemia.

### **3.9. Treatment for Familial Hypercholesterolemia**

The overall goal of treatment is to lower the risk for atherosclerotic heart disease by lowering the LDL cholesterol levels in the blood stream. Atherosclerosis is a condition in which fatty material collects along the walls of arteries. This fatty material thickens, hardens, and may eventually block the arteries. Atherosclerosis happens when fat and cholesterol and other substances build up in the arteries and form a hardened material called plaque. The plaque deposits make the arteries less flexible and more difficult for blood to flow leading to heart attack and stroke. The first step in treatment for an individual who has heterozygous familial hypercholesterolemia is changing the diet to reduce the total amount of fat eaten to 30 percent of the total daily calories. This can be done by limiting the amount of beef, pork, and lamb in the diet; cutting out butter, whole milk and fatty cheeses as well as some oils like coconut and palm oils; and eliminating egg yolks, organ meats and other sources of saturated fat from animals. Dietary counseling is often recommended to help people to make these changes in their eating habits.

Exercise, especially to lose weight, may also help in lowering cholesterol levels.

Drug therapy is usually necessary in combination with diet, weight loss, and exercise, as these interventions may not be able to lower cholesterol levels alone. There are a number of cholesterol-lowering medications that are currently used. The first and more effective choice are drugs called "statins." Other drugs that may be used in combination with or instead of the statins are: bile acid sequestrant resins (for example, cholestyramine), ezetimibe, nicotinic acid (niacin), gemfibrozil, and fenofibrate. Individuals who have homozygous familial hypercholesterolemia need more aggressive therapies to treat their significantly elevated levels of cholesterol. Often drug therapies are not sufficient to lower LDL cholesterol levels at the desired goal and these individuals may require periodical LDL apheresis, a procedure to

"clean up" LDL from the blood stream, or highly invasive surgery such as a liver transplant.

#### **4.0 CONCLUSION**

In this unit we have discussed the bioactive food compounds. From the study we have been able to demonstrate the effects of bioactive food compounds on health and effects of health foods on health, which should lead to the development of functional foods that will keep people healthy according to their individual needs. Bioactive food components can modify transcription, translation and metabolism. A table showing the class and dietary sources of bioactive compounds that may influence certain forms of cancer and tumor behaviours was also displayed in this unit. The effect of Alcohol on both those that have slow and fast alcohol metabolism was stated. Intake of coffee is associated with an increased risk of MI (myocardial Infarction only among individuals with slow caffeine metabolism (Cornelis et al. 2006), suggesting that caffeine increases risk of MI since it is the only major compound in coffee that is known to be detoxified by CYP1A2.

This unit has also taught us that a person who inherits a mutated copy of the gene causing familial hypercholesterolemia from both parents is said to have homozygous familial hypercholesterolemia. This is a much more severe form of familial hypercholesterolemia than heterozygous familial hypercholesterolemia. Each of this person's children will inherit one copy of the mutated gene and will have heterozygous familial hypercholesterolemia.

#### **5.0 SUMMARY**

Some bioactive food components can protect the body from the potential harmful effect of phytochemical in the food. Moderate alcohol consumption has been associated with a lower risk of heart disease. Therefore, if there is a causal protective effect of moderate alcohol on risk of heart disease, this effect would be expected to be stronger in individuals with the slow ADH1C genotype compared to those with fast metabolism.

The unit further discussed the circulating lipid risk factors which is the most heavily researched area is that concerned with genes that determine levels of circulating lipid risk factors – lipoproteins, LDL, HDL cholesterol triglycerides and lipoprotein particles. Familial hypercholesterolemia which is inherited in families in an autosomal dominant manner.

We also looked at the major symptoms and signs of familial hypercholesterolemia which include: high levels of total cholesterol and LDL cholesterol, a strong family history of high levels of total and LDL cholesterol and/or early heart attack, elevated and therapy-resistant levels of LDL in either or both parents, xanthomas, xanthelasmas, corneal arcus and also when angina is present. In this unit we also discussed gene and familial hypercholesterolemia; A person who inherits one copy of the gene mutation causing familial hypercholesterolemia from one of his/her parents is said to have heterozygous familial hypercholesterolemia. This person has a 1 in 2 (50 percent) chance to pass on the mutated gene to each of his/her children. The diagnosis and treatment for familial hypercholesterolemia was also treated.

## 6.0 TUTOR-MARKED ASSIGNMENTS

- 1a. In a tabular form list the bioactive food components under the following headings; name of bioactive food component, class and food sources.
- b. Intake of coffee is associated with an increased risk of MI (myocardial Infarction only among individuals with slow caffeine metabolism! Why?
  - 2a. Explain what you understand by familial hypercholesterolemia.
    - b. Discuss the relationship between gene and familial hypercholesterolemia.
    - c. Describe the predisposing factors of familial hypercholesterolemia.

## 7.0 REFERENCES/FURTHER READINGS

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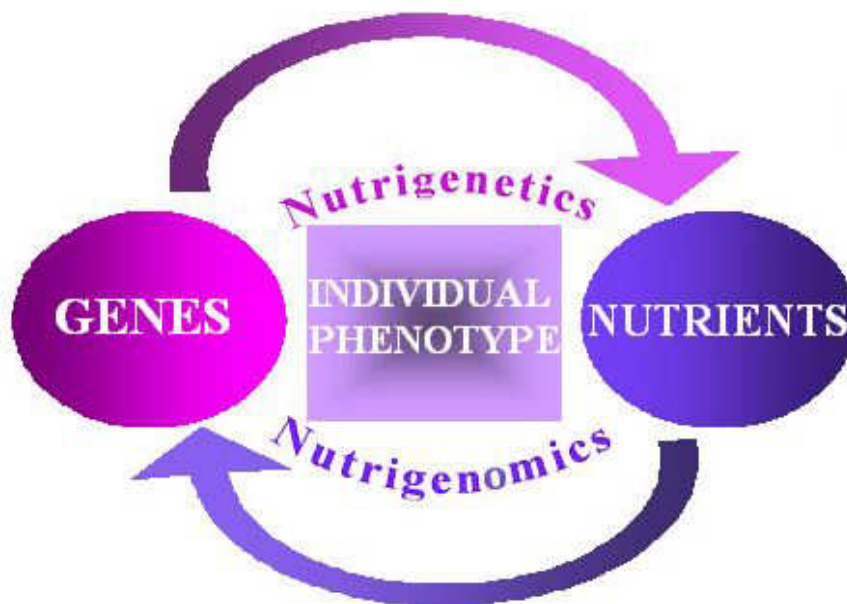
## UNIT 5 NUTRIGENOMIC IN RELATION TO NUTRIGENETICS

### CONTENTS

- 1.0 Introduction
- 2.0 Unit Objective
- 3.0 Main content
  - 3.1 Proteomics
  - 3.2 Metabolomics
  - 3.3 Epigenetic
  - 3.4 Diet Alters Expression of Genetic Information
  - 3.5 Aging; Calories and Oxidation
  - 3.6 Lactose Intolerance
  - 3.7 Micronutrients
  - 3.8 Potential Value of Nutrigenomics
  - 3.9 Personalized Nutrition?
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor-Marked Assignments
- 7.0 References/further readings

### 1.0 INTRODUCTION

The influence of nutrients on genes expression is called Nutrigenomics, while the heterogeneous response of gene variants to nutrients, dietary components and developing nutraceuticals is called Nutrigenetics.

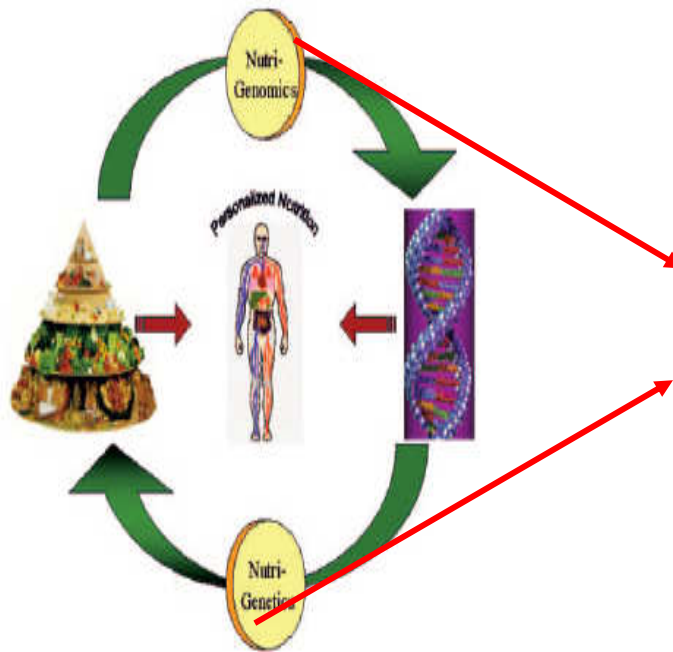


**Nutrigenomics**

**And**

**Nutrigenetics:**

## Two Sides Of A Coin



Mutch, FASEB 2005

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- Describe the implication of the presence or absence of key protein in our body.
- Discuss the relationship between nutrigenomics and nutrigenetics.
- Explain personalized nutrition.

## 3.0 MAIN CONTENT

### 3.1 Proteomic

Proteomics uses protein separation usually on 2-D gels followed by quantification and identification often using mass spectrometric techniques to investigate differential protein expression again under different conditions or with different underlying pathology.

The presence or absence of certain key proteins can give information about the early stages of disease.

### 3.2 Metabolomics

Metabolomics (or metabonomics) examines global patterns of metabolites present in the cell or in body fluids in response to specific dietary exposures.

This requires powerful statistical tools (chemometric analysis) to investigate differences in the NMR spectra or analyses detected by HPLC or other separation.

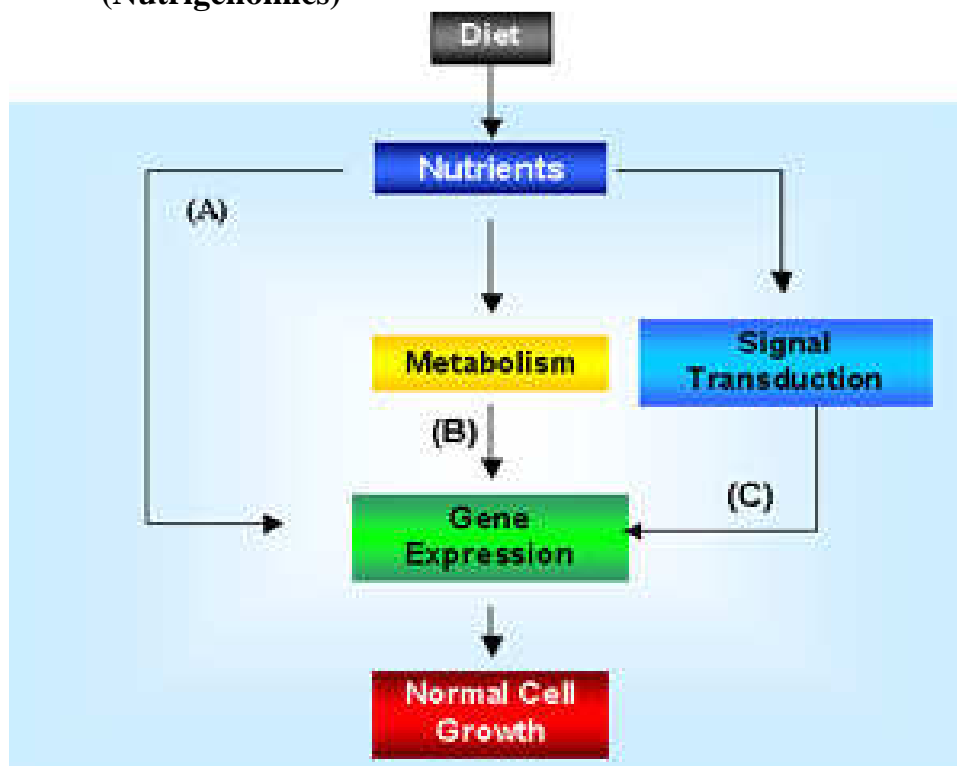
### 3.3 Epigenetics

Epigenetics is the study of modifications to the genome which are copied from one cell generation to the next but which do not involve changes to the primary sequence.

These changes, mediated through modification of chromatin proteins such as histones and through the methylation of DNA, contribute to the regulation of transcription.

It thus provides a way for the genome to “learn from experience”, regulating gene expression in response to dietary and other exposures and leading to altered cellular phenotypes associated, for example, with chronic disease or ageing.

### 3.4 Diet Alters Expression of Genetic Information (Nutrigenomics)





### 3.5 Aging; Calories and Oxidation

Additional information of nutrient regulation of gene regulation evolved from the field longevity research. Key genes involved in aging are regulated through SIRT1 (sirtuin 1), a gene first found in yeast. SIRT1 “monitors” the energy balance in the cell through the ratio of NAD<sup>+</sup>/NADH. Caloric restriction increases NAD levels which activates SIRT1. The protein encoded by this is a histone deacetylase which alters chromatin structure and hence expression of genes. In the yeast and other model systems, calorie restriction increases life span.

### 3.6 Lactose Intolerance

Lactose intolerance (also known as lactase non-persistence or hypolactasia) is another excellent example of adverse genome/diet interactions. Lactose intolerance limits the use of fresh milk (and milk products) among adults and produces a painful digestive condition commonly associated with nausea, cramps bloating, gas, and diarrhoea. Epidemiological data indicate that the frequency of lactose intolerance varies widely depending on geography, age, race and ethnicity.

#### **The Molecular Explanation:**

Investigators have identified a genetic variant or SNP (C/T13910), 14kb up stream of the *LCH* (lactase-phlorizin hydrolase) locus on the large arm of human chromosome 2 (2q21). This variant, first identified in nine extended Finnish families, is responsible for lactose tolerance, (i.e., lactase persistence) or the ability for adults to consume fresh milk and milk products without complications

### 3.7 Micronutrients

Approximately 40 micronutrients are needed in the human diet. Suboptimal intakes of specific micronutrients have been associated with CVD (Vit B, E, and carotenoids), cancer (folate, carotenoids), neural tube defects (folate), and bone mass (Vit D) B6, B12 and folate deficiencies, are associated with increased serum homocysteine levels.

### 3.8 Potential Value of Nutrigenomics

Diet is an important environmental factor that interacts with the genome to modulate disease risk. A clear understanding of these interactions has the potential to support disease prevention through optimization of dietary recommendations. Nutrigenomics has emerged as a rapidly developing research area with great potential to yield findings that could change the way dietary guidelines for populations and recommendations

for individuals are established and advised in the future. Information on how diet-gene interactions influence phenotypes found to be predictive biomarkers of disease have the potential for identifying novel targets for prevention or treatment with dietary factors.

### 3.9 Personalized Nutrition?

Already specific subgroups are already targeted with “subgroup nutrition” (e.g., cholesterol-lowering margarines).

A debate is arising as to whether nutrition should enter into the area of linking genetic differences with tailor-made nutrition.

As well as research into the role of nutrition in disease prevention (Gorman, 2006), there is an increasing focus on the role of nutrition in the optimisation of health at all life stages, and the related need for tools to properly quantify health in order to substantiate the beneficial impacts of dietary change. Nutritional status induces subtle changes in body function that are more difficult to detect than, for example, response to drug treatment. These small differences are, however, extremely important in determining risk of chronic disease in the longer term. Consequently, substantial effort has gone into characterising diet–health relationships through the development of circulating and other functional biomarkers.

In order to capture the subtle biological effects that occur as a consequence of diet, investigators have expanded cohort sizes and attempted to control the homogeneity of study volunteers (and therefore normal genetic heterogeneity) through selection according to a range of specified healthy phenotypes. This introduces bias into the findings, with the result that outcomes from controlled intervention studies may not reflect the full range of phenotypic variability arising from diet–gene interactions that exist within, and between, populations. Recognition that an individual’s nutrition-related health condition is a complex function of their genome and life-long dietary exposure (Fig. 1), has led to the realisation that nutrition is essentially a gene–environment interaction science.

$$\text{health status} = \int_{\text{conception}}^{\text{now}} \text{exposure} \times \text{genome}$$

**Fig. 1:** Gene–Environment Interaction

Although it is widely accepted that the health status is a result of the interaction of our environment (of which diet is a major part) and our genome, it remains a challenge to quantify the three components of the above equation. This series of reviews addressed each of the components, together with new research strategies that aid in unraveling this equation.

#### **4.0 CONCLUSION**

It is clear therefore that the extensive genotype information that is available to investigators studying nutrigenetics needs to be matched with comprehensive phenotypic and behavioural information, which in the case of dietary information needs to go beyond the classical use of food frequency questionnaires (FFQs). Because of the diverse and often unreliable findings, studies including FFQs have limited value as the basis for subsequent dietary intervention, which might be used for evaluating genotype-specific responses to diet.

#### **5.0 SUMMARY**

In this unit we have discussed proteomic which revealed that the presence or absence of certain key proteins can give information about the early stages of disease. We also explained that metabolomics (or metabonomics) examines global patterns while epigenetics of metabolites present in the cell or in body fluids in response to specific dietary exposures is the study of modifications to the genome which are copied from one cell generation to the next but which do not involve changes to the primary sequence. This unit described how diet alters expression of genetic information (*nutrigenomics*), aging; calories and oxidation, lactose intolerance, micronutrients, potential value of nutrigenomics and personalized nutrition. Under potential value of nutrigenomics we explained that diet is an important environmental factor that interacts with the genome to modulate disease risk. A clear understanding of these interactions has the potential to support disease prevention through optimization of dietary recommendations. Also, personalized nutrition has the recognition that an individual's nutrition-related health condition is a complex function of their genome and life-long dietary exposure has led to the realisation that nutrition is essentially a gene–environment interaction science.

#### **6.0 Tutor-Marked Assignments**

1. Explain the term Personalized nutrition
2. Write short notes on the following:
  - a. Proteomic
  - b. Metabolomic

c. Epigenetics.

## **7.0 REFERENCES/FURTHER READINGS**

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