
UNIT 7 FOOD ALLERGY

Structure

- 7.0 Objectives
- 7.1 Introduction
- 7.2 Food Allergens
- 7.3 Allergic Mechanism
- 7.4 Anaphylaxis
- 7.5 Structure of an Allergen
- 7.6 Clinical Manifestation of Allergy
- 7.7 Identification of Food Allergies
- 7.8 Testing of Food Allergies
- 7.9 Treatment of Food Allergies
- 7.10 Let Us Sum Up
- 7.11 Keywords
- 7.12 Some Useful Books
- 7.13 Answers to Check Your Progress

7.0 OBJECTIVES

After reading this unit, you will be able to:

- define food allergy and allergens;
- explain the allergic mechanism;
- elaborate the structure of allergen;
- enlist the clinical manifestations of allergy;
- identify the food allergies; and
- describe testing and treatment of food allergies.

7.1 INTRODUCTION

Food allergy, which is defined as an immunologically mediated hypersensitivity reaction to food, may manifest itself by producing symptoms in various organs. It is an immune system response to a food that the body mistakenly believes as harmful. Once the immune system decides that a particular food is harmful, it creates specific antibodies to it. The most frequent manifestation includes gastrointestinal symptoms (e.g., vomiting, diarrhoea, constipation, abdominal pain), cutaneous symptoms, (e.g. urticaria, eczema, itching, swelling,) and respiratory symptoms (e.g., wheezing) although systemic anaphylaxis may also occur. Actually whenever a person eats the food to which he is prone, the immune system releases massive amounts of chemicals, including histamine in order to protect the body. These chemicals trigger a cascade of allergic system reactions that can affect the respiratory system, gastrointestinal tract, skin or cardiovascular system. Food allergens are predominantly protein in nature. Any major alteration in the molecular structure usually results in loss of allergenic potential.

Food allergy is most prevalent in infants and children (approximately six per cent are affected). The most common allergens from which human suffer early

in life include cow milk, eggs, wheat, and peanuts. Children tend to become tolerant to these food stuff with age i.e., typically outgrow their allergies. However, two per cent of the adult population continues to suffer from some form of food allergy and usually do not lose their allergies.

A child is said to have an allergy when his or her body reacts abnormally to a substance in the environment that does not bother most people. The symptoms of food allergy can range from gastrointestinal disturbances such as nausea, vomiting, abdominal pain, gas and diarrhoea, to nasal inflammation, asthma, eczema, headache and any other signs and symptoms.

7.2 FOOD ALLERGENS

Although an individual could be allergic to any food such as fruits, vegetables and meats, they are not as common as the following eight, which account for 90 per cent of all allergic reactions. They are: (1) milk (2) egg (3) peanut (4) tree nut (alnut, cashew etc) (5) fish (6) shell fish (7) soy and (8) wheat. According to another view, the major allergen includes sunflower seeds, cotton seeds (meal, not oil), poppy seed, molasses and beans other than green beans, peas and lentils, tartrazine, sulphite and latex are also treated as major serious allergens. Whereas, refined peanut oil does not cause allergic reactions in peanut sensitive subject but unrefined peanut oil causes allergy and should be regarded as 'major serious allergen'. It is noteworthy that the food protein fragments responsible for an allergic reaction are not broken down by cooking or by stomach acids or enzymes that digest food. These proteins can cross the gastrointestinal lining, travel through the bloodstream and cause allergic reaction through out the body.

7.3 ALLERGIC MECHANISM

It is common for several members of the same family to have 'hay fever', asthma or eczema. The tendency for these diseases to cluster in certain families is known as 'atopy' and the affected individual are described as being 'atopic'. The amount of food that must be eaten in order for an atopic person to become sensitized is unknown. Atopic infants have been reported to become sensitized to minutes quantities of food allergens present in their mother's milk. Once a person has become sensitized, ingestion of milligram quantities of food allergens may be enough to trigger on allergic reaction. Being exposed to vapours from fish, can be enough for some individuals to cause allergy. Environmental agents such as pollens, mold spores, dust, mites and some foods cause allergies. Following a sufficient exposure to these allergens, atopic persons may become sensitized and produce Immunoglobulin E (IgE) — antibodies to these or other allergens. A predisposed person must be exposed to a specific food before IgE is formed. As this food is digested for the first time, tiny protein fragments prompt certain cells to produce specific IgE against that food. After IgE antibodies are produced, they circulate in the blood and bind to basophiles (white blood cells) and to the surface of body cells called 'mast cells'. Mast cells and basophils contains granules packed with chemicals such as histamine. When an allergic person encounters an allergen to which he/she has previously produced IgE antibodies, the allergens combines with the IgE antibody on the surface of mast cells and basophils. This triggers a complex series of reactions that results in the release of histamine and other mediators from the granules inside the mast cells and basophils, which are the agents responsible for producing symptoms of allergy.

Once released, these compounds enter the blood stream and bind to 'receptors' on other cells in the body causing typical allergic symptoms. They may include sneezing, swelling of various body parts and in severe reactions, fall in blood pressure or shock. The mast cells releases chemicals in the nose and throat, so the allergic person may experience itching of tongue or mouth and may have trouble breathing or swallowing. If the mast cells in the gastrointestinal tract are involved, the person may have diarrhoea or abdominal pain. Skin mast cells can produce intense itching. The severity of the allergic reaction to a food depends on how sensitized the person is and the amount of the allergenic food that is eaten. Allergic reaction may sometimes take place in two phases. The first stage or first symptoms go away on their own or with medication only to reoccur four to six hours later. Some food sensitive persons who have experienced more than one allergic reaction usually report the same 'early warning signs' and symptoms with each reaction. However, it cannot be assumed that each reaction will take the same course and last for the same period of time. The timing and location of an allergic reaction to food is affected by digestion. For example, an allergic person may first experience a severe itching of the tongue or "tingling lips". Vomiting, cramps or diarrhoea may follow. As allergens enter the bloodstream and travel throughout the body, they can cause a drop in blood pressure, hives or eczema or asthma when they reach the lungs. The onset of these symptoms may vary from a few minutes to an hour or two after the food is eaten.

7.4 ANAPHYLAXIS

Anaphylactic shock, although rare is the most severe and dangerous form of an allergic reaction. It can be life threatening if not treated immediately. The first symptom is an itchy or swollen tongue, wheezing and tightening of the throat. This may be followed by chest pain, a sharp drop in blood pressure, irregular heart beat, and loss of consciousness. Symptoms can occur within 5 to 15 minutes and may be mild at first but will usually get worse very quickly. It is critical that any person with these symptoms should be taken to an emergency room as soon as possible. The reaction can develop over severe hours or severe symptoms can reappear up to an hour later.

7.5 STRUCTURE OF AN ALLERGEN

The identification of allergens by their chemical structure is not possible. It overlooks the fact that allergens are defined by misguided immune system. Specificity of the allergic reaction is correlated with the chemical structure of the allergens, but the development of these specificities depends primarily on the individually conditioned immune system of patients. The immune system is not able to recognize the whole structure of macromolecule such as proteins or glycoproteins but smaller sections of the molecule called determinants or epitopes. However, it cannot be excluded that there exists an interdependence of the three dimensional presentation of the epitope, with the whole structure of the molecule. Given epitope display a different immunological behaviour depending upon the whole structure of the molecule. In principle, the immune system reacts with two different kinds of epitopes, conformational ones, which are made up by the (three dimensional) surface area of a molecule formed by discontinuous sections of the primary protein structure and continuous or linear epitopes built directly by the primary protein structure. Normally, allergens especially aero allergens

and pollen related food allergens possess conformational epitopes but in classical food allergens linear epitopes are found.

7.6 CLINICAL MANIFESTATION OF ALLERGY

Many people often have gas, bloating or another unpleasant reaction to something they eat, this is not an allergic response. Such a reaction is thought to not involve the immune system and is called "Food intolerance".

Allergic reactions may effect any system of the body, producing one or more of the following manifestation:

- Respiratory System : 'Hay fever', bronchial asthma, running nose or nasal congestion, sneezing, coughing, wheezing and breathing difficulties.
- Skin : Urticaria (nettle-rash or hives) antineurotic oedma, eczema, purpura, swelling of lips, mouth, tongue, face and/or throat (angioedema).
- Gastrointestinal system : Abdominal pain, vomiting, diarrhoea, dyspepsia.
- Cardiovascular system : Circulatory collapse, shock and omelophylaxis.
- Nervous system : Headache
- Genitourinary system : Haematuria
- Locomotor system : Swelling or haemorrhage into joints
- Systemic : Anaphylactic shock (severe generalized shock).

Parents often are convinced that a child has a food allergy, when in fact the child's allergic symptoms are brought on by other environmental factors such as pollen, dust or house pets. Adverse reactions to foods were confined in only 22 per cent of children 3 to 16 years of age, and 75 per cent of the association of symptoms with foods were found to be erroneous or psychologic in nature. Relatively few foods cause most (91 per cent) of the problems: nuts (43 per cent), egg (21 per cent), milk (18 per cent) and soya (9 per cent). Denaturation of many proteins also results in loss of their allergenic potential because of the alternate molecular rearrangement.

Thus raw or pasteurized milk may give rise to allergic reactions in a person hypersensitive to the lactoglobulins or lactumins which it contains, while thoroughly boiled milk or evaporated milk, its offending proteins denatured, may be consumed by the same individual without untoward reactions. Milk sensitivity may be complicated by individual variations in degree of sensitivity, differing antibody responses and pathophysiologic changes. Thus, the ingestion of cows milk in sensitized infants may cause the occult loss of significant qualities of blood into the gastrointestinal tract with milk because they may be just as allergenic and there is evidence that in a general population of older children approximately five per cent are sensitive to soybean derivatives. It is a frequently asked question "Is goat milk a safe alternative to cow milk"? But, it should be kept in mind goat's milk protein is similar to cow's milk protein and may, therefore cause a reaction in milk-allergic individuals. It is not a safe alternative.

Allergic reactions to food may be acute or mild, immediate (within four hours) or delayed (upto 72 hours) after the food causing the problem is difficult to

pinpoint .The most frequent offenders are eggs, milk, and wheat, with corn, chocolate, nuts, fish, shellfish, peas and peanuts being the next. Other common foods that may be trouble making are grape fruit, oranges, strawberries and tomatoes. Food additives, colouring and flavours also encourage allergic reactions in some children.

Genetic factors appear to be involved. Children whose parents are allergic (not necessarily to food) are more at risk. When allergies run in the family, it is wise to follow the procedure suggested for gradually introducing new foods into the infant's or child's diet so problem foods can be identified promptly.

7.7 IDENTIFICATION OF FOOD ALLERGIES

When allergies do develop, identifying their cause can be a long and sometimes frustrating process for foods. Skin tests, which are used for identifying non - food causes of allergies, are not very reliable for foods. Usually some form of an eliminating diet is used. For example, an entire food group may be eliminated from the diet, if allergic symptoms clear up after a week or so, the foods may be added back, one at a time, allowing time for symptoms to reappear. If the symptoms do not disappear when a food group is eliminated, deleting another food group may be tried.

Another aid to identify the cause of an allergy is for parents to keep a diet diary of all the foods a child eats, including snacks, and also include a log of symptoms. What they are and when they occur? Sometimes a cause and effect relationship can be seen from this record.

7.8 TESTING OF FOOD ALLERGIES

The most reliable method of testing for food allergies, which is rarely employed by the practicing physician, is the double-blind food challenge. This method eliminates personal bias and prejudice for neither child, parent, nor physician knows what food is being ingested. It is accomplished by giving the child a dried form of the suspected food in opaque capsules or masking it in another food known to cause no reaction. If the child shows the same symptoms that were seen when the challenged food was eaten, then the symptoms are not psychological or imaginary but may be due to an allergic reaction. Besides this, prick skin test, blood test or RAST (Radio allegro sorbant test) are also in practice to determine existence of allergy. A prick skin test is usually cheaper and can be done in the doctor's office. The doctor places a drop of the substance being tested on the patients' fore arm or back and pricks the skin with a needle, allowing a tiny amount to enter the skin. If the patient is allergic to the substance, a wheal (mosquito bite like bump) will form at the site within 15 minutes.

A RAST requires a blood sample. The sample is sent to a medical laboratory where tests are done with specific foods to determine whether the patient has IgE antibodies to that food. The results are usually received within one week. Although both tests are reliable, there are instances where one is better than the other. Many doctors use a RAST for young children or patients who have eczema or other skin problems that would make it difficult to read the results of a prick skin test. The results of either test are combined with other information, such as a history of symptoms and a food challenge, to determine whether a food allergy exists.

7.9 TREATMENT OF FOOD ALLERGIES

Once the cause of a child's food allergy is identified. As treatment, the only orally effective treatment is to eliminate the offending foods such as wheat, milk, eggs. Voiding them is extremely difficult because they are found as ingredients in so many common foods. Constant label reading is necessary and often many ready-made foods must be avoided.

Recipes for home-made foods must be remodeled to avoid the problem ingredients. In some cases, another form of the food can be tolerated. For example, cooked fruits are less likely to cause problems than fresh fruits.

Nutritional deficiency can result if a child is placed on a several restricted diet prescribed to combat a real or imagined food allergy. One hopeful aspect of childhood allergies is that sometimes the child will grow out of that, after age five and eventually will be able to tolerate the problem foods. Antihistamines and bronchodilators can be used to treat less severe symptoms. To provide the necessary information to a doctor, it is better to keep a food diary, for one to two weeks, of everything you eat and note down the symptoms you experience. This information combined with a physical examination and lab tests will help the doctor to determine which food is causing the allergy for which treatment is done easily.

Check Your Progress

1) Define food allergy.

.....

2) What is anaphylaxis?

.....

3) Fill in the blanks.

- a) Food allergens are mostly.....in nature
- b) Food allergy is defined as
- c) Common allergens from which human suffer are,
 and
- d), and
 are common symptoms of food allergens.
- e) Ingestion of quantities of food allergen is enough to
 trigger an allergic reaction.

- f) Allergic patients are described as
 - g) is released in most of allergic reactions.
 - h) Allergic reaction takes place in phases.
- 4) Discuss the clinical manifestation of allergic reactions.
-
-
-
-
-
- 5) How allergy can be identified?
-
-
-
-
-
- 6) What is double blind food challenge? Is there a cure for food allergy?
-
-
-
-
-
- 7) What is the difference between food allergy and food intolerance? Justify your answer with example.
-
-
-
-

7.10 LET US SUM UP

Food allergy is immunologically mediated hypersensitivity reaction which may manifest itself by producing gastrointestinal, cutaneous and respiratory symptoms resulting in nausea, vomiting, abdominal pain, gas and diarrhoea, nasal inflammation, asthma, eczema, headache and any other signs and symptoms. There are several allergens. Food allergies are most common in children. Allergic reactions are mild, immediate and accurate. Identification of cause of food allergies and testing of food allergies are important aspects followed by treatment.

7.11 KEY WORDS

Allergens	:	Substance causing allergy
Atopic person	:	Person sensitive to allergen
Cutaneous	:	Skin
Flavour	:	Taste and smell
Hypersensitive	:	Extra sensitive
Inflammation	:	Swelling
Manifestation	:	Happenings
Medication	:	Taking medicines
Occult	:	Hidden / faint
Pasteurized	:	Heat treated
Sensitized	:	Become sensitive
Trigger	:	Give rise to

7.12 SOME USEFUL BOOKS

Benjamin, T.B. (1978). *Human nutrition formerly the Heinz Handbook of Nutrition*. Tata McGraw-Hill Publishing Company. Pp 417-433.

Davidson, S.S. and R. Passmore, (1966). *Human Nutrition and Dietetics*. Lingstone Ltd, Edinburgh, London, pp 640-647.

Dorothy, A.U. Martin B. and Dewar, S.P. (1983). *Nutrition the challenge of being well nourished*. 2nd edition Reston Publishing Company. Inc. pp 374-376.

Khader, V. (2003). Food Allergies. *In Food Nutrition and Health*, Kalyani Publishers, New Delhi. Pp 311-313.

Sicherer, S. (2002). *Food Allergy*. Lancet 360: 701-710.

7.13 ANSWERS TO CHECK YOUR PROGRESS

- 1) Food allergy may be defined as an immunologically modified hypersensitivity reaction to food, may manifest itself by producing symptoms in various organs.
- 2) Anaphylaxis is anaphylactic shock, which is rare but is most severe and dangerous form of an allergic reaction leading to death. The first symptom is itchy or swollen tongue, wheezing and tightening of throat. This may be followed by chest pain, a sharp drop in blood pressure, irregular heart beat and loss of consciousness.
- 3)
 - a) Protein.
 - b) An immunologically mediated hypersensitivity.
 - c) Cow milk, eggs, wheat/ peanut.
 - d) Gastrointestinal, cutaneous and respiratory symptoms.

- e) Milligrams.
 - f) Atopic.
 - g) Histamine.
 - h) Two.
- 4) Clinical manifestation of allergic reactions include respiratory symptoms such as hay fever, bronchial asthma, running nose, sneezing, coughing. Skin lesion such as urticaria, eczema, purpura, and gastrointestinal symptoms such as abdominal pain, vomiting, diarrhoea. Nervous symptoms such as headache and locomotor such as swelling or hemorrhage into joints.
 - 6) Skin test, diet eliminating test and maintenance of diet diary can be done to identify the allergy.
 - 7) The most reliable method of testing for food allergies is the double blind food challenge. It is accomplished by giving the child a dried form of the suspected food in opaque capsule or masking it in another food known to cause no reaction. If the child shows the same symptoms that were seen when the challenged food was eaten, then the symptoms are not psychological or imaginary but may be due to an allergic reaction. Currently, there are medications that cure food allergies. Strict avoidance is the only way to prevent a reaction.
 - 8) A food intolerance is an adverse food induced reaction that does not involve the, immune system. Lactose intolerance is one example of a food intolerance. A person with lactose intolerance lacks an enzyme that is needed to digest milk sugar. When the person eats milk products, symptoms such as gas, bloating and abdominal pain may occur. A food allergy occurs when the immune system reacts to certain food. The most common form of an immune system reaction occurs when the body creates immunoglobulin (IgE) i.e. antibodies to food. When these IgE antibodies react with the food, histamine and other chemicals (called Mediators) cause hives, asthma, or other symptoms of an allergic reaction.