HEA & Teagasc
Functional Food

The Importance of Diet

In the interests of both health and longevity we should all be aiming to eat a balanced diet, i.e. a diet with all the major food groups in the correct proportions and quantities. People who do not have a balanced diet may be either undernourished or malnourished.

(i) **Undernourished** means not having enough food; this condition is prevalent in many countries and sadly often leads to death by starvation.

(ii) **Malnourished** means having too much, or too little, of one food group (e.g. too much fat, or too much sugar, or not enough vitamins or roughage). This is not uncommon today in developed countries including Ireland. Too much of one type of food, such as fat or carbohydrates, can lead to health issues such as *obesity* and *cardiovascular disease*. Insufficient vitamin intake can cause *deficiency diseases* such as scurvy (lack of vitamin C) or rickets (lack of vitamin D).

What are Nutrients?

A *nutrient* is a chemical that an organism needs to live and grow, or is used in an organism's *metabolism*, and which must be taken in from its environment. The main food groups are:

Protein - body *tissues*, *hormones* and *enzymes*. Proteins are composed of amino acids.

Carbohydrate - energy supply and energy store (*glycogen*).

Lipids (fats and oils) - energy store and insulation.

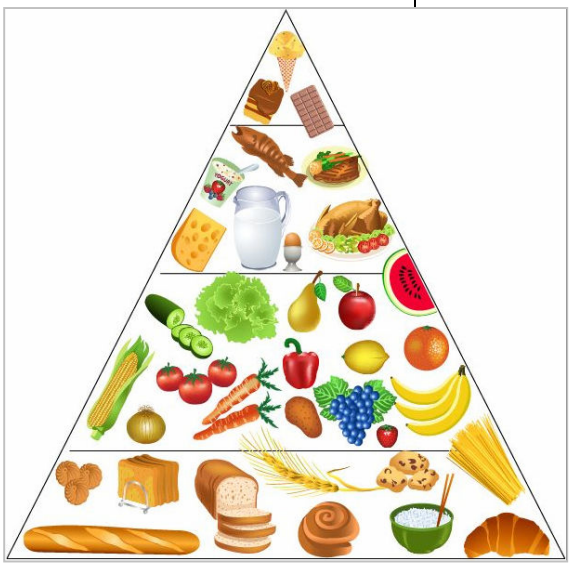
Vitamins - *co-enzymes* and *anti-oxidants*.

Minerals - bones, teeth and *haemoglobin*, etc.

Roughage - indigestible material which helps prevent constipation, ease digestive transit, and reduce the risk of bowel cancer.

The Food Pyramid

The Food Pyramid gives an indication of the proportions of each type of food in a balanced diet. Our bodies can make some nutrients (e.g. vitamin B in the large intestine and vitamin D in the skin, using sunlight), but essential nutrients are those that can only be found in food.



What is Functional Food?

Functional food, sometimes called *medicinal food*, is any fresh or processed food claimed to have a *health-promoting* or *disease-preventing* property beyond the basic function of supplying nutrients. This term was coined in Japan in the 1980s where there is a government approval process for functional foods called Foods for Specified Health Use (FOSHU). The aim is to produce better health in older people and thus reduce medical costs.

Functional food can be split into two main groups:

Improved function - for example, caffeine enhances *cognitive function* and a particular yoghurt promotes "digestive transit"

Disease prevention / **health promotion** - these foods come under a variety of headings:

- **Low fat foods:** the fat is reduced (e.g. low fat milk) or removed with the aim of reducing the risk of cardiovascular disease.
- **Fortified foods:** processed foods with health promoting additives, e.g. "Super Milk" with added folate (which reduces the risk of babies being born with neural tube defects) and possibly vitamins such as A, C and E which are *anti-oxidants*. Anti-oxidants prevent the formation of reactive free radicals which are thought to damage cells and promote ageing.
- **Stenols and sterols:** added to some dairy products: These plant extracts are thought to prevent uptake of cholesterol by competing with *LDL* (*Low Density Lipoproteins*, often called 'bad cholesterol'). Some of these have been endorsed by the *World Heart Federation* as part of a healthy balanced diet.
- **Probiotics:** are defined by the World Health Organisation as 'Live microorganisms, bacteria or yeasts, which when administered in adequate amounts confer a health benefit on the host'. Strains of *Lactobacillus* and *Bifidobacterium* are the most widely used probiotic bacteria. You will probably have heard of *Bifidus essensis*, *B. digestiva* and *L. casei immunitas* in certain yoghurt products. These are the names of subspecies of *Bifidobacterium animalis* — an *anaerobic*, rod-shaped bacterium, which can be found in the large intestines of most mammals, including humans. Both names (*Bifidus* and *Bifidobacterium*) are still used on labels. It seems that they help protect us from *pathogenic gut bacteria* by out-competing them and thus preventing them from getting a foothold in our *large intestines*.
- **Prebiotics**: These are non-digestible food ingredients that stimulate the growth or activity of beneficial bacteria in the digestive system. The prebiotic is not digested in the stomach or small intestine and passes through to the large intestine where it is fermented by the *gut microflora* that resides there. In this way prebiotics are thought to improve a person's health. Prebiotics are usually carbohydrates and the most common are nutritionally classed as *soluble fibre*. Most forms of dietary fibre exhibit some level of prebiotic effect and common sources include bananas, tomatoes, onions, oatmeal, unrefined wheat and barley and many kinds of beans.

Human breast milk plays an important role in the development of a healthy immune system in infants and it is thought that this may, in part, be due to prebiotic effects. This is because breast milk is known to contain *oligosaccharides*. An *oligosaccharide* is a carbohydrate that consists of a number of *monosaccharides* (simple sugars).

Maintenance of a healthy gut flora is dependent on many factors, especially the quality of food intake. The modern adage "five a day of fruit and vegetables", when combined with regular *cardiovascular exercise*, and a reduction in fat intake (especially saturated fat) are the most important guidelines. Functional foods, on top of this, will probably contribute to a healthier life.

The Scientific Basis

To date, there is no legal framework governing the claims made for functional food. The European Union has established *Functional Food Science in Europe (FUFOSE)* with the aim of establishing a scientific approach to regulating claims in this area. The organisation includes government representatives, food manufacturers and scientists. There is also a need to educate the public so that they understand scientific terms and be more discerning in making food choices.

FUFOSE supports the development of two types of health claims relevant to functional foods, which must always be valid in the context of the whole diet and must relate to the amounts of foods normally consumed.

- *Type A* or *enhanced function* claims are for additional physiological or psychological functions and biological activities beyond the food's established role in growth, development and other normal functions of the body.
- *Type B* or *reduction of disease-risk* claims relate reduction of the risk of a specific disease or condition because of nutrients or non-nutrients contained within the food (e.g. *folate* can reduce a woman's risk of having a child with *neural tube defects*, and sufficient *calcium* intake may help to reduce the risk of *osteoporosis* in later life).

Teagasc

Teagasc is Ireland's agricultural and food development authority. As such Teagasc provides research, advisory and training services for the agriculture and food industry in Ireland. The organisation also works in close co-operation with their counterparts in other countries around the world.

Teagasc employs over 200 scientists and 300 technicians in research, and many other specialist staff in training and advisory roles. In total, over 1,500 staff are employed at over eighty locations throughout the country. The research carried out by Teagasc is essential to the development of competitive and sustainable agricultural and food industries.

You can find this and other Teagasc lessons on *www.sta.ie*.

Find out about Teagasc, the people who work there and the many scientific projects they are involved in at www.teagasc.ie.

HEA

The Higher Education Authority (HEA) is the national agency with responsibility for allocating funding to our universities, institutes of technology and other designated higher education institutions. In addition, the HEA advises Government on all aspects of higher education and research.

Research is vital to Ireland's future economic and social development and the HEA is committed to putting in place the buildings and the support mechanisms that will allow researchers and their ideas to flourish. There are increasing opportunities in higher education institutions and in business and industry for those who wish to pursue a career in research.

You can find this and other HEA lessons on *www.sta.ie*.

More information is available about the Higher Education Authority, their programmes, policies and publications at www.hea.ie.

HEA & Teagasc Functional Food Teaching Notes

Syllabus References

The appropriate syllabus references are:

Leaving Certificate Biology

1.3.4 Nutrition

- Biomolecular sources and components of food.

1.3.7 Nutrition

- Metabolic role of biomolecules.

2.5.9 Genetics

- Genetic engineering - animal application.

3.1.2 Micro-organisms

- Distribution in nature.

3.3.4 Transport and Nutrition

- Human digestive system.
- Functions of symbiotic bacteria.
- Benefits of fibre.

3.3.6 Transport and Nutrition

- Balanced human diet.

This also applies to ***Junior Certificate Science***.

Learning Outcomes

On completion of this lesson, students should be able to understand:

- The difference between undernourished and malnourished.
- The main components of a balanced diet and their functions.
- Some of the possible results of a poor diet.
- Two deficiency diseases and their causes.
- The meaning of 'essential' with regard to nutrients.
- The meaning of 'functional' in relation to food.
- That functional foods can prevent disease and improve health.
- The benefits of a low fat diet.
- The meaning of 'fortified' in relation to food and some examples of fortified foods and their claimed benefits.
- The effects of stenols and sterols.
- The difference between probiotics and prebiotics and examples of each.
- That many claims of functionality have yet to be confirmed by credible scientific research and that because it is implied in a TV advertisement does not mean that it is actually true.

General Learning Points

The following information can be used to revise the lesson's main learning points and inform discussion.

- The benefits and components of a balanced diet.
- Treating information, especially advertising claims, with a fair amount of scepticism.
- If in doubt look to scientific bodies such as Teagasc for unbiased information and guidance.
- Where to find out more information on functional foods.
- The variety of ways foods can be altered to make them functional.
- The possible benefits of functional foods.

HEA & Teagasc Functional Food Exercises

Student Activities

Look at your household food items and list the different types of functional foods they contain.

State if the food has had something added (+), removed (–) or if its functionality is intrinsic (o).

Note the substance(s) added or removed.

Note its claimed benefit.

Construct a table with the following headings: Food; Added / Removed or Intrinsic; Substance; Benefit.

Read the labels very carefully and highlight those foods you think are making a credible and accurate claim.

True/False Questions

a) Fortified foods have beneficial components added. **T F**

b) Undernourished children are not getting enough food. **T F**

c) Proteins are made from amino acids. **T F**

d) Essential amino acids can only be obtained from food. **T F**

e) Indigestible plant material is called roughage. **T F**

f) Lack of vitamin D causes scurvy. **T F**

g) Prebiotics are micro-organisms which when administered in sufficient quantity can confer a health benefit. **T F**

h) Stenols and sterols cause cholesterol build-up. **T F**

i) A high fat diet can contribute to cardiovascular disease. **T F**

j) Roughage helps prevent bowel cancer. **T F**

k) Beans are not a good source of roughage. **T F**

l) Gluten-free foods are functional foods. **T F**

Check your answers to these questions on www.sta.ie

Examination Questions

Leaving Certificate Biology (HL) 2006, Q. 1

Answer five of the following:

a) In the human diet zinc, iron and copper are examples of .

b) The walls of xylem vessels are reinforced with .

c) Where in a cell would you expect to find phospholipids?

d) Vitamin is an example of a water-soluble vitamin.

e) Name a disorder associated with a deficiency of the vitamin that you have named in (d) or of another named vitamin in the human diet.

f) What are the final products of the digestion of a protein?

Leaving Certificate Biology (OL) 2006, Q. 3

a) Name the four elements that are always present in protein.

b) Name one other element that may be present in protein.

c) Give two good sources of protein in the human diet.

d) Name a test or the solution(s) that is (are) used to detect protein in a food source.

e) State the following in relation to (d):

1. The initial colour of the solution(s) .

2. The final colour if protein is present .

Leaving Certificate Biology (HL) 2005, Q. 1

Answer five of the following by writing a word in the space provided.

a) Cellulose is an example of a structural .

b) Vitamins are either water-soluble or soluble.

c) Fats are composed of oxygen, hydrogen and .

d) When an iodine solution is added to a food sample and remains red-brown in colour, is absent.

e) When two monosaccharides unite they form a .

f) Removal from the body of the waste products of metabolism is called .

Did You Know?

- Teagasc, at its Moorepark facility, is currently conducting comprehensive research and development work, in association with UCC, on the development of functional foods.
- In Ireland functional food sales exceed € 100 million per year.
- About 75% of consumers attach relatively more importance to enrichment than the other product attributes.
- Cows can now produce lactose free milk.
- Folic acid-enriched food, as well as lowering the risk of coronary heart disease, also has a powerful protective effect against some birth defects.
- Omega-3 oils are vital for the healthy development of a baby's brain and eyes during pregnancy and the first 6-12 months of life.
- Sugarless chewing gums and candies made with sugar alcohols do not promote tooth decay and so may be classed as functional foods.
- Cranberry juice lowers the chances of a urinary tract infection.
- Older people and women are more positive about functional foods than are other respondents.
- If you want to be sure that a food really has a functional component look for a "health claim" on the label.

Biographical Notes

Ilya Ilyich Mechnikov (Eli Metchnikoff) (1845-1916)

Metchnikov was born in a village near Kharkiv (Ukraine) and from his youth had a keen interest in natural history. He studied science in Kharkiv University and completed the four year course in just two years. He undertook research in Germany for some years and in 1867 took up a senior lecturing post in the new University of Odessa and later in St Petersburg. In 1870 he was appointed professor of zoology in Odessa.

He developed an interest in bacteria and in the immune system. He resigned his post in Odessa in 1882 to establish a private research laboratory. He discovered, among other things, that certain white blood cells could engulf and kill foreign cells such as bacteria (phagocytosis). Many renowned scientists, including Pasteur, found this hard to believe.

A few years later (1888) Mechnikov went to Paris and met with Pasteur who offered him a post in the Pasteur Institute, where he remained for the rest of his life. In 1908 he was awarded the Nobel Prize for Medicine in recognition of his work on phagocytosis. That same year Ernest Rutherford won the Nobel Prize for Chemistry.

Mechnikov began to drink sour milk every day, in the belief that lactic acid bacteria (lactobacillus) had a beneficial health effects and prolonged life. Others researched this connection between a healthy gut and a healthy body further and today many functional foods contain some strain of lactobacillus.

Revise the Terms

Can you recall the meaning of the following terms? Reviewing terminology is a powerful aid to recall and retention.

Anaerobic, diabetes, deficiency disease, essential nutrients, food pyramid, fortified, gut micro flora, malnourished, monosaccharides, nutrient, obesity, oligosaccharide, prebiotics, probiotics, roughage, sterols / stenols, undernourished.

Check the Glossary of Terms of this lesson at www.sta.ie