

## **Health and medicine**

**Department of Chemistry**  
The Open University of Sri Lanka

# Health and medicine

## Introduction

It is well known that most of the artificial food additives could pose a real *health risk* unless we control or limit the amount of food additives that we eat. It is important to remember, *you are what you eat*. In this lesson, we intend to touch on some important aspects related to health and medicine. Discovery of various modern drugs (pharmaceuticals) led to controlling the spread of diseases and even to wipe out some diseases completely. Do not forget, prevention is better than cure.

We all agree that the quality and quantity of food we take and the amount of work/exercise we do will keep us healthy. We should take a *balanced diet* to obtain the daily requirement of food (or energy), vitamins and minerals needed to carry out various biological functions. We know that some diseases are caused by deficiency of certain essential nutrients, vitamins and minerals. Some diseases are associated with excess intake of food, minerals and chemicals too.

Use of soap and detergents is necessary in keeping our personal hygiene and a clean household environment. We need to control or avoid the spreading of viruses and bacteria, particularly in water and air. For example, deaths due to typhoid fever decreased dramatically after the introduction of water chlorination. Let us first consider the importance of water in terms of hygiene and health.

## 1. Water and health

Water is a chemical and it is essential for our health and well-being. We can live without food for weeks, but only 5-7 days without water. If the water in a human body is reduced by just 1%, one feels thirsty. When the loss reaches 5%, muscle strength weakens. At a 10% loss, confusion and blurred vision occur, and a 20% reduction may result in death. Our cells are filled with water solutions in which the reactions of life take place. Life would not be possible on earth without water and its unique properties.

Water collected in reservoirs, lakes and rivers are not fit to drink as it may be contaminated with *pathogenic micro organisms*. Water we use is treated with chemicals to purify it. Water treatment includes settling down suspended solids with aluminium sulphate  $\text{Al}_2(\text{SO}_4)_3$  and calcium hydroxide  $\text{Ca}(\text{OH})_2$ . These compounds form a sticky gel of aluminium hydroxide,  $\text{Al}(\text{OH})_3$ , that collects *suspended clay and dirt particles* on its surface. It is now filtered through sand and gravel to remove suspended matter. The filtered water is then aerated by

spraying it into the air. This treatment removes some odours, and improves the taste of water. If necessary, charcoal filtration is done to get rid of any colour present.

As the final step, *chlorine* or another disinfectant is added to kill any remaining bacteria. Chlorine is added in one of three forms: Chlorine gas ( $\text{Cl}_2$ ), sodium hypochlorite ( $\text{NaOCl}$ ) or calcium hypochlorite [ $\text{Ca}(\text{OCl})_2$ ]. Anyway the antibacterial agent generated in solution by all three substances is *hypochlorous acid*,  $\text{HOCl}$ . The degree of chlorination is adjusted so that a very low concentration of  $\text{HOCl}$ , between 0.075 and 0.600 ppm, remains in solution in order to protect water against further bacterial contaminations. Boiling of water kills almost all germs present in it. Thus, it is better to boil and allow water to cool before you drink it.

## 2. Alcohol and health

Alcohol (refers to ethanol) is probably the most widely used legalized drug of all. There are few adults who have not experienced its effects. Although it is often regarded as a stimulant, it is in fact a *sedative*. Alcohols tend to change your mood, more outgoing or more depressive. Alcoholic drinks are usually divided into *beers* (alcohol content less than 5%), *wines* (alcohol content around 10%), and *spirits* (alcohol content over 30%). The maximum alcohol content which can be produced by fermentation is about 15%, depending on the type of yeast used. Stronger drinks have to be made by adding extra ethyl alcohol.

Alcohol is absorbed into the bloodstream through the walls of the stomach, small intestine and colon at a rate which depends on a number of factors, including the presence of food which slows down absorption. Once in the blood stream it is transported to all parts of the body. Thus the same dose of alcohol will have a less marked effect on a large person than on a smaller one. High doses of alcohol produce disorientation, confusion, blurred vision, slurred speech, poor muscle control, nausea and vomiting. *Thus you should never drive under the influence of alcohol or any drug.* The maximum level of alcohol in the blood at which driving is permitted is 80 mg of alcohol per 100  $\text{cm}^3$  of blood, which corresponds to a level in the breath of 35 micrograms per 100  $\text{cm}^3$  of breath.

## 3. Body temperature and health

Our body temperature remains relatively constant even when the temperature of our surroundings increases or decreases. Normal body temperature is considered to be 37.0 °C when measured orally. However, a normal individual can have an oral temperature as low as 36.1 °C upon awakening in the morning and a temperature as high as 37.2 °C before bedtime in the late evening. Many chemical reactions of the body take place at the temperature of 37.0 °C, but the rates of these reactions increase when the temperature increases and decrease when the temperature decreases.

The increase in body temperature known as *fever* is a protective mechanism that allows the germ killing processes of the body *to take place at increased rates*. The pulse rate increases and breathing is faster in an individual with fever. This takes place because the body is attempting *to supply increased amounts of oxygen* to be used up as reactions occur.

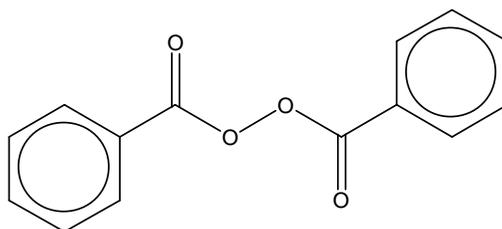
Body temperature fluctuates in response to extreme weather conditions (*e.g.* very hot summers and cold winters). In extremely hot environments, the capacity of the body's cooling system has to over work, and the body temperature increases. Body temperatures more than 3.5 °C above normal begin to interfere with bodily functions. Temperatures higher than 41.1 °C can result in convulsions and can cause permanent damage to some vital organs, especially in children.

**Hypothermia** develops when body's internal heat generation is not sufficient to balance heat lost to very cold surroundings. The body's temperature drops, and at 28.5 °C the afflicted person appears pale and cold and may have an irregular heart beat. Unconsciousness usually results if the body temperature drops below 26.7 °C. *The respiration also slows down* and becomes shallow, and oxygenation of body tissues decreases. Even though we have built-in cooling and heating systems, their capacities and abilities to maintain a constant normal body temperature are limited.

#### 4. Oxidizing agents and health

Oxidizing agents such as *antiseptics* and *disinfectants* are used in day-to-day life as they play important roles in protecting our health because of their ability to kill micro organisms or inhibit their growth. Antiseptics kill micro organisms or prevent their growth on living tissue (*e.g.* skin). Disinfectants kill micro organisms on objects such as floor, table tops, *etc.* *Phenol* is a disinfectant but causes blistering of the skin, while its derivatives have both better germicidal properties and are safer to use as antiseptics. A well known example is "Dettol", which is used as an antiseptic in lower concentrations in treating minor cuts and wounds. But in higher concentrations it is used as a disinfectant. Let us see some more examples for important antiseptics and disinfectants.

A solution containing 3% hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) dissolved in water is an antiseptic often used in treating minor cuts and abrasions. Acne (skin disease) is treated with a more powerful oxidizing agent in the form of ointments that contain 5-10% benzoyl peroxide [C<sub>6</sub>H<sub>5</sub>C(=O)O]<sub>2</sub>. Before surgery, the area of skin in which the incision is to be made is usually disinfected with a solution that contains iodine (I<sub>2</sub>).



**Figure 1** Structure of benzoyl peroxide

Liquid laundry bleaches are water solutions containing 5% *sodium hypochlorite* (NaOCl). Often combined with a detergent, these solutions clean and disinfect sinks, toilets, and similar fixtures. Calcium hypochlorite [Ca(OCl)<sub>2</sub>] is the active ingredient in some bleaching powders used in hospitals for disinfecting clothing and bedding. Elemental chlorine (Cl<sub>2</sub>) is added to drinking water as well as swimming pools to kill *pathogenic organisms*. Ozone (O<sub>3</sub>) is a useful disinfectant for drinking water. It is more costly and has less residual disinfecting power than chlorine, but it imparts no unpleasant taste to the water. Compounds that release chlorine or bromine (Br<sub>2</sub>) are added to the water of spas and hot tubs (used for bathing) to prevent micro organisms from growing.

## 5. Junk food and health

Junk food refers to fast food which are easy to make and easy to consume. Their nutritional value is very poor and more likely to cause ill-health to the consumer. The taste and colour are the most attractive features in junk food. Junk food is high in fat, sugar or salt. Some popular fast food items are hamburgers, cheeseburgers, French fries, milk shakes, chicken pies, potato chips and pizza. Eating junk food could be one of the main contributing factors for development of cancer, obesity and hyperactivity. Regular eating of junk food makes one gain weight quickly. Obesity can cause many other health complications, including cardiovascular diseases, high in cholesterol, diabetes, heart attacks, strokes, sleep apnea (brief pauses in breathing) *etc.*

## 6. Fat and body weight

Many people want to lose weight (body fat), and this has resulted in numerous diet and exercise schemes of dubious value. Both carbohydrate and fat are major sources of energy. During rest or very sedentary activities, fat is the main source of body energy. However, after about six minutes of exercise, carbohydrates become the predominant source and maintain a decreasing predominance until the exercise has gone on for about forty minutes, at which time fat and carbohydrates each provide about half the energy. Beyond forty minutes, fat provides an increasing percentage. This information supports the idea that a few long exercise sessions will burn more body fat than a large number of shorter sessions that total the same amount of time.

## 7. Blood glucose

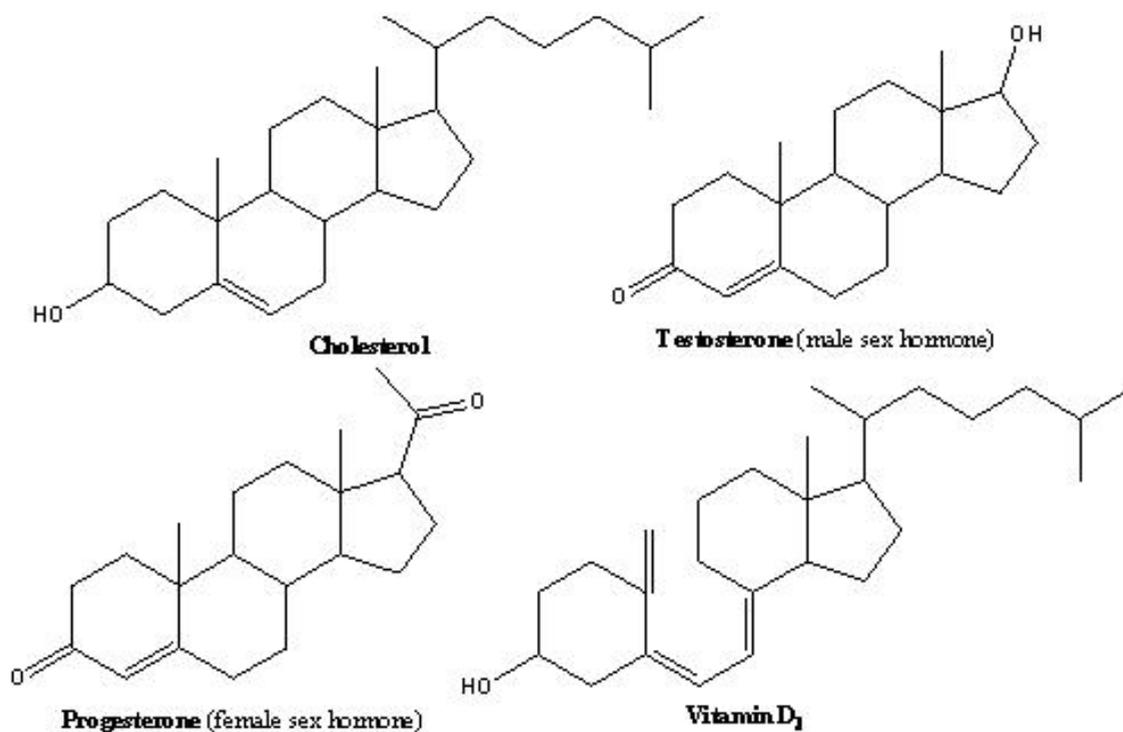
Glucose by far is the most plentiful monosaccharide found in blood, and the term blood sugar usually refers to glucose. In adults, the normal *blood sugar level* (the amount of glucose, in milligrams, present in 100 ml of blood) measured after a fast of 8-12 hours is in the range of 70-110 mg/100ml. The blood sugar level reaches a maximum of approximately 140-160 mg/100ml about 1 hour after a carbohydrate-containing meal.

If the blood sugar level is below the normal, a condition called **hypoglycaemia** exists. Because glucose is the only nutrient normally used by the brain for energy, mild hypoglycaemia leads to drowsiness as brain cells are deprived of energy. Severe hypoglycaemia can cause *convulsions*. When the blood glucose concentration is above normal, the condition is referred to as **hyperglycaemia**. If blood glucose levels exceed approximately 180 mg/100ml, the sugar is not completely reabsorbed by the kidneys, and glucose is excreted in urine. This disease is called as **diabetes mellitus**, and one of the most prevalent metabolic defects in human beings.

The two main forms of diabetes mellitus are *juvenile-onset diabetes* and *maturity-onset diabetes*. In juvenile-onset diabetes, which usually appears in children before the age of 10, practically *no insulin is produced by the pancreas*. The disease can be controlled through daily injection of insulin and a strict dietary programme. Maturity-onset diabetes is usually diagnosed in adulthood. In this form of the disease, *a normal amount of insulin is secreted, but the body does not respond to it properly*. Obesity is often associated with maturity-onset diabetes.

## 8. Cholesterol and health

Cholesterol is normally made by the liver and is found in all tissues where it helps to increase the permeability of the cell membrane. Cholesterol derivatives in the skin are converted to vitamin-D when it is exposed to sunlight. Vitamin-D<sub>3</sub> mediates intestinal absorption of calcium and also bone calcium metabolism. A high concentration of cholesterol in the blood is considered to be a risk factor for cardiovascular diseases. Therefore, people are advised to regulate their dietary intake of cholesterol, which is found in milk, butter, cheese, egg yolks, and other food rich in animal fats. In addition, reducing *the amount of saturated fatty acids* in the diet appears to lower cholesterol production by the body.



**Figure 2** Cholesterol, male and female sex hormones, vitamin-D<sub>3</sub>

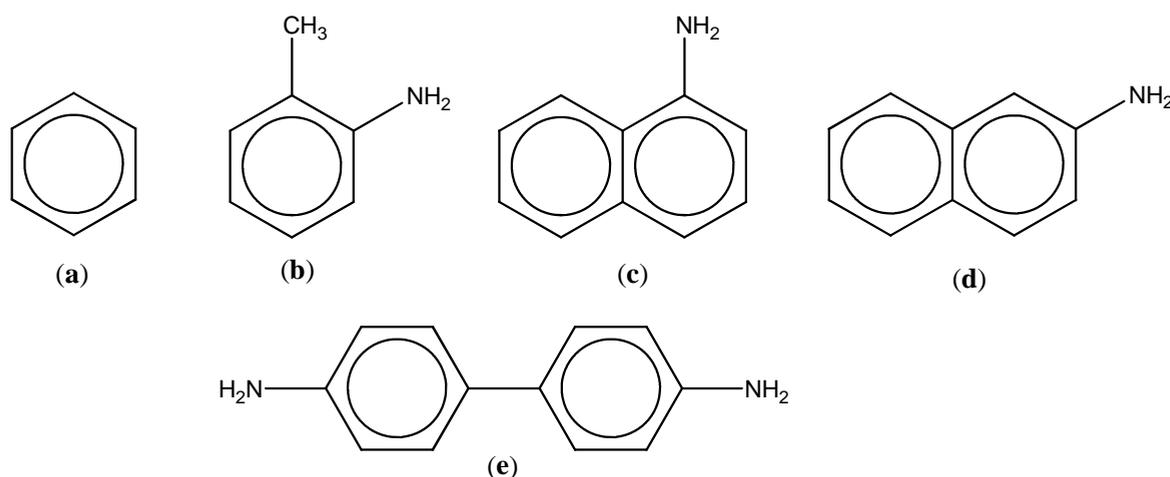
Cholesterol is a precursor for other important steroids, including the bile salts, and male and female sex hormones. An average adult has about 250 g of cholesterol in his or her body. Cholesterol levels can be normalized through proper exercise and by reducing dietary calorie intake for example reducing hydrogenated fats and taking more polyunsaturated fatty acids. Both *low-density lipoproteins* (LDLs) and *high-density lipoproteins* (HDLs) are involved in the transport of cholesterol in the bloodstream. LDLs carry cholesterol from the *liver to the body tissues*, whereas HDLs act as scavengers that pick up excess cholesterol throughout the body and *transport it to the liver*.

## Anabolic Steroids

These are synthetic steroidal hormones used to stimulate muscle and bone growth. These were developed initially to help very weak patients to regain muscle tissue. Ironically, their use has now become perverted by the strong who seek to become even stronger. Some athletes have found taking anabolic steroids to build muscles and boost their athletic performance. Anabolic steroids have an impact on a person's health including increased risk of heart attack, strokes and liver problems. Other undesirable body changes may occur including breast development and genital shrinking in men, masculinisation of the body in women, and acne and hair loss in both sexes.

## 9. Cigarette smoke and health

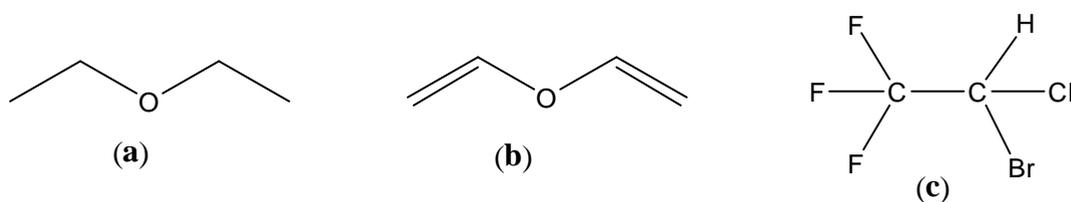
A number of simple benzene derivatives and polycyclic aromatic hydrocarbons are known to cause cancer. Polycyclic aromatic compounds contain two or more fused benzene rings. These cancer-causing polycyclic aromatic hydrocarbons are often formed as a result of heating organic materials to high temperatures. Some are present in tobacco smoke, automobile exhaust, and in burned or heavily browned food. Such compounds are believed to be responsible for the high incidence of lung and lip cancer among cigarette smokers. Those who smoke heavily face increased risk of getting cancer. Benzene, *o*-toluidiene,  $\alpha$ - and  $\beta$ -naphthylamine, diphenyl derivatives such as 4-aminodiphenyl, 4-nitrodiphenyl, benzidine, and nitrosoamine are known to cause cancer.



**Figure 3** (a) Benzene, (b) *o*-toluidiene, (c), (d)  $\alpha$ - and  $\beta$ -naphthylamine and (e) benzidine.

## 10. General anesthetics

Anesthetics are compounds that induce the *loss of sensation* in a specific part (local anesthetic) or all of the body (general anesthetic). A local anesthetic operates on localized nerve centres, and the person remains conscious while a general anesthetic acts on the brain to produce unconsciousness as well as insensitivity to pain. Diethyl ether was used as an anesthetic for surgical operations way back in 1850. Since it is extremely flammable and frequently produces nausea diethyl ether is seldom used in some countries. Divinyl ether is an anesthetic that acts more rapidly and is less nauseating than diethyl ether.



**Figure 4** (a) Diethyl ether, (b) divinyl ether and (c) halothane

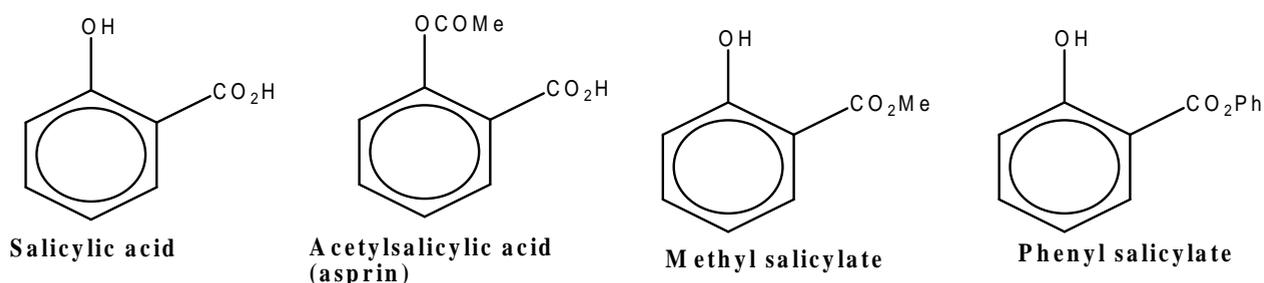
Chloroform ( $\text{CHCl}_3$ ) was first used as an anesthetic by James Simpson in 1846 to relieve pain of childbirth of his patients. It is not used now as it could cause liver damage and the effective anesthetic dose is rather close to the lethal dose. Numerous inhalation anesthetics are not ethers at all. Nitrous oxide, also known as “laughing gas”, is used as a general anesthetic by some dentists because its effects wear off quickly. Halothane (trade name is fluothane)  $\text{CHBrClCF}_3$ , currently a popular general anesthetic, is a simple halogen derivative of ethane.

## 11. Medicine and pharmaceuticals

Medicinal chemistry is the science that deals with the discovery or design of new therapeutic chemicals and their development into useful medicines (pharmaceuticals or drugs). More recently, chemists have designed, synthesized, and characterised a vast array of prescriptive and over-the-counter drugs. Today, drugs help patients regulate their blood sugar, blood pressure, cholesterol, and allergies. Identification of a drug and to make it available to general public takes about ten years of research and development, including animal testing and human trials, costing millions of dollars. A pioneer drug is the first version of a drug that is marketed under a brand name, such as valium and ventolin. A generic drug (chemical name, diazepam and salbutamol) is chemically equivalent to the pioneer drug (trade name, valium and ventolin), but cannot be marketed until the patent protection on the pioneer drug has run out after 20 years. In this section we consider common drugs such as aspirin, paracetamol, and salbutamol.

## Pain killers

In the 1800s, chemists working with willow bark extracts discovered that salicylic acid is responsible for the analgesic (pain-reducing) and antipyretic (fever-reducing) effects. Although salicylic acid produces these desired effects, the compound is quite acidic and produces severe irritation of the stomach lining. In 1893 a German chemist attempted to overcome this drawback by converting salicylic acid to its less acidic ester, acetylsalicylic acid or **aspirin**.



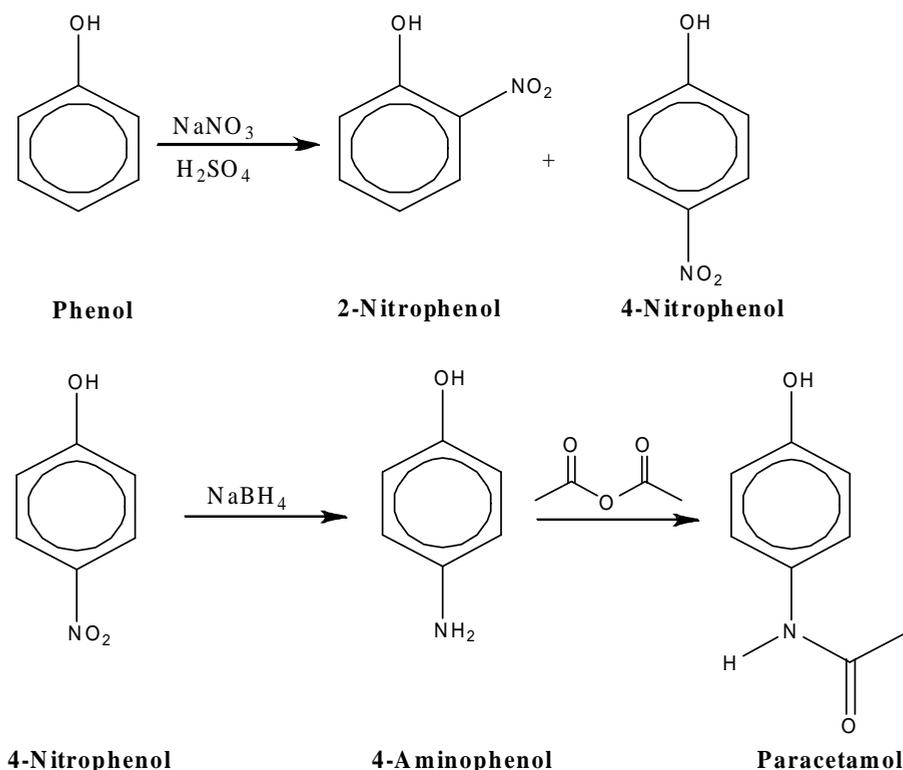
*Figure 5 Salicylic acid, acetylsalicylic acid, methyl salicylate and phenyl salicylate*

Aspirin is remarkably versatile. It works in the brain to reduce fever but does not reduce normal body temperature. It relieves a variety of simple pains such as headache, sprain, and toothache. Recently, aspirin has also been shown to be effective in preventing specific kinds of strokes and heart attacks. Aspirin is an anti-inflammatory agent and is often used in the treatment of arthritis.

Even though aspirin is an excellent and useful drug, it occasionally produces adverse effects, such as gastrointestinal bleeding and allergic reactions (skin rashes and asthmatic attacks), that cannot be tolerated by some individuals. Children who are feverish with flu or chickenpox should not be given aspirin.

Methyl salicylate (**oil of wintergreen**) can be obtained by etherifying salicylic acid with methanol. The antiseptic drug, phenyl salicylate (**Salol**) can be prepared similarly. It is also used in the manufacture of lacquers, adhesives, waxes and polishes.

**Paracetamol** can be easily prepared from phenol (PhOH). First, PhOH is nitrated with H<sub>2</sub>SO<sub>4</sub> and NaNO<sub>3</sub> to give a mixture of 2-nitrophenol and 4-nitrophenol. 4-Nitrophenol has a higher boiling point and it is separated by fractional distillation. Reduction of 4-nitrophenol with NaBH<sub>4</sub> gives 4-aminophenol. Acetylation of 4-aminophenol with acetic anhydride (or acetyl chloride) results in the formation of 4-acetylamino phenol (paracetamol).

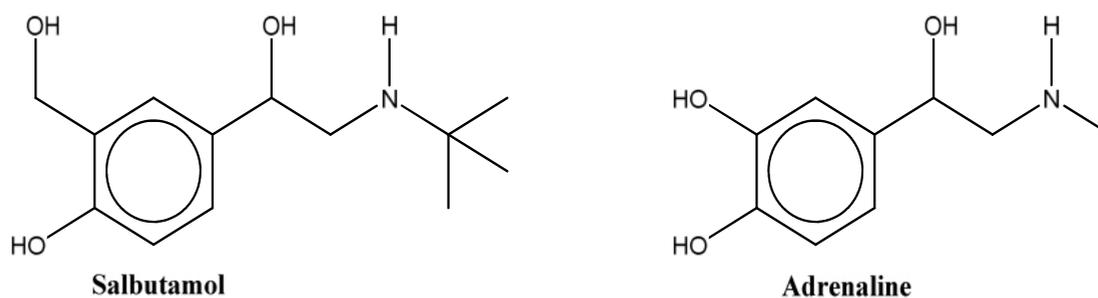


*Figure 6 Synthesis of paracetamol*

Paracetamol is used as a pain relief. It has analgesic properties similar to those of aspirin. But its anti-inflammatory effects are weaker than those of aspirin.

### Asthma and salbutamol

Asthma is a very common disease, effecting many young and adults. If you are not asthmatic it is more likely you know someone who is suffering from asthma. The usual symptoms of asthma are wheezing and breathlessness. It is possible to treat the symptoms which are caused by the airways in the lungs being narrowed and inflamed. In order to relieve an asthma attack the narrowed airways have to be opened. Inhalers containing salbutamol (trade name is Ventolin) used to dilate (widen) the bronchi (airways). This class of drugs is called bronchodilators.

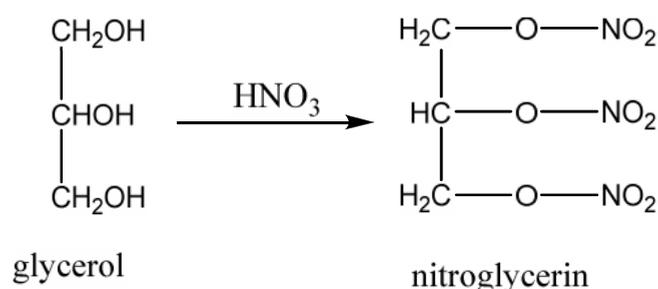


**Figure 7** Salbutamol (the active compound in Ventolin inhalers) and adrenaline

Glaxo Company took about ten years to develop and launch this drug called Ventolin. Salbutamol is extremely effective drug and it is being widely used today after it was discovered in 1969. Glaxo chemists looked closely at the chemical structure of adrenaline, which is the nature's bronchodilator. Adrenaline is released in the body by the adrenal glands, when we are frightened or excited or feel the need to act quickly. Can you note that these two structures are similar? *Spot the difference between them.*

### Nitroglycerine as a medicine

Nitroglycerine is a nitrate ester resulting from the reaction of nitric acid and glycerol. It was discovered to be a powerful explosive. Surprising as it may seem, nitroglycerine is also an effective medicine. It is used to treat patients with angina pectoris, sharp chest pains caused by an insufficient supply of oxygen to the heart muscle. Nitroglycerine relaxes cardiac muscle and causes a dilation of the arteries, thus increasing blood flow to the heart and relieving pains. Nitroglycerine can be administered in small tablets, which are placed under the tongue during an attack of angina. It is rapidly absorbed into the bloodstream and finds its way to heart muscle within seconds.



**Figure 8** Formation of nitroglycerine

Since 1860, nitroglycerine has been used as an active ingredient in the manufacture of explosives, particularly *dynamite*. Pentaerythritol tetranitrate  $\text{C}(\text{CH}_2\text{ONO}_2)_4$  is the major ingredient of the Semtex plastic explosive used by terrorists.

## Tea and health

The health benefits of tea are due to *antioxidant* properties of flavonoids present in tea. Flavonoids reduce fat deposits on walls of arteries that pump blood to the heart. This makes tea a simple but effective defence against heart attacks and cardiovascular diseases. It is known that flavonoids increase production of nitrous oxide (NO) that contributes towards the relaxation of blood vessels. This relaxation of blood vessels makes it easier for the blood to flow through the body. Black tea has a high percentage of flavonoids compared to food such as apples, red onions, blue berries and cocoa. Tea can also induce alertness and a calming effect due to the presence of caffeine and thiamin (vitamin B<sub>1</sub>) in it.

## Summary

Water is a chemical and it is essential for our health and well-being. Severe dehydration may result in death. Drinking water is chlorinated to kill micro organisms and bacteria. Alcohol (refers to ethanol) is probably the most widely used legalized drug of all. It is a *sedative*. Alcohol is absorbed into the bloodstream through the walls of the stomach, small intestine and colon. High doses of alcohol produce disorientation, confusion, blurred vision, slurred speech, poor muscle control, nausea and vomiting.

Our body temperature is 37.0 °C when measured orally. The pulse rate increases and breathing is faster in an individual with fever. Body temperatures more than 3.5 °C above normal begin to interfere with bodily functions. Temperatures higher than 41.1 °C can result in convulsions and can cause permanent damage to some vital organs, especially in children. Hypothermia develops when body's internal heat generation is not sufficient to balance heat lost to very cold surroundings.

Antiseptics kill micro organisms or prevent their growth on living tissue (*e.g.* skin). Disinfectants kill micro organisms on objects such as floor, table tops, *etc.* A solution containing 3% hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) dissolved in water is an antiseptic often used in treating minor cuts and abrasions. Acne (skin disease) is treated with a more powerful oxidizing agent in the form of ointments that contain 5-10% benzoyl peroxide. Liquid laundry bleaches are water solutions containing 5% sodium hypochlorite (NaOCl). Often combined with a detergent, these solutions clean and disinfect sinks, toilets, and similar fixtures.

Junk food refers to fast food which are easy to make and easy to consume. Their nutritional value is very poor and they are high in fat, sugar or salt. Eating junk food could be one of the main contributing factors for development of cancer, obesity and hyperactivity.

In adults, the normal blood sugar level (the amount of glucose, in milligrams, present in 100 ml of blood) measured after a fast of 8-12 hours is in the range of 70-110 mg/100ml. The blood sugar level reaches a maximum of approximately 140-160 mg/100ml about 1 hour after a carbohydrate-containing meal. If the blood sugar level is below the normal, a condition called hypoglycaemia exists. Mild hypoglycaemia can cause dizziness as brain cells are deprived of energy. Severe hypoglycaemia can cause convulsions and shocks. When the blood glucose concentration is above normal, the condition is referred to as hyperglycaemia. The two main forms of diabetes mellitus are juvenile-onset diabetes and maturity-onset diabetes.

Cholesterol is produced by the liver and is found in all body tissues where it helps to organize cell membranes and control their permeability. A high level of cholesterol in the blood is considered to be a risk factor for cardiovascular diseases. Cholesterol is a precursor for other important steroids, including the bile salts, and male and female sex hormones. Both low-density lipoproteins (LDLs) and high-density lipoproteins (HDLs) are involved in the transport of cholesterol in the bloodstream. Synthetic steroidal hormones stimulate muscle and bone growth. Some athletes have been taking anabolic steroids to build muscles and boost their athletic performance. Cancer-causing polycyclic aromatic hydrocarbons are often formed as a result of heating organic materials to high temperatures. Some are present in tobacco smoke, automobile exhaust, and in burned or heavily browned food.

Anesthetics are compounds that induce a loss of sensation in a specific part (local anesthetic) or all of the body (general anesthetic). Diethyl ether was used as an anesthetic for surgical operations way back in 1850. “Laughing gas”, is used as a general anesthetic by some dentists because its effects wear off quickly. Halothane (or fluothane) is a popular general anesthetic.

Medicinal chemistry deals with the discovery or design of new therapeutic chemicals and their development into useful medicines. Chemists have designed, synthesized, and characterised a vast array of prescriptive and over-the-counter drugs. Today, drugs help patients regulate their blood sugar, blood pressure, cholesterol, and allergies. Aspirin is remarkably versatile. It works in the brain to reduce fever but does not reduce normal body temperature. It relieves a variety of simple pains such as headache, sprain, and toothache. Asthma is a very common disease, effecting many young and adults. Inhalers containing salbutamol (ventolin) used to dilate (widen) the bronchi (airways). Nitroglycerine is a powerful explosive and an effective medicine. It is used to treat patients with angina pectoris, sharp chest pains caused by an insufficient supply of oxygen to the heart muscle. The health benefits of tea are due to its antioxidant properties shown by flavonoids present in it.



## Learning Outcomes

Once you have finished studying this lesson you should be able to

- explain the importance of water and water purification
- describe health effects due to variation in body temperatures
- use of alcohol and its health effects
- explain the role of cholesterol and its health effects
- explain the role of anesthetics
- explain medicinal aspects of aspirin, paracetamol, and salbutamol.



---

## Activities

---

1. Describe main steps of purification of water.
  2. Explain health effects as the extent of dehydration of a body increases.
  3. Why do people get fever?
  4. What is hypothermia? What happens when body temperature drops below  $26\text{ }^{\circ}\text{C}$ ?
  5. What is meant by “junk food”? How does it affect your health?
  6. What are polycyclic aromatic compounds?
  7. What are common disinfectants?
  8. Write a short account on aspirin.
  9. Explain the role of cholesterol and its health effects.
  10. (i) What are the symptoms of asthma?  
(ii) What is the drug prescribed to facilitate breathing?  
(iii) How does it work?
  11. How does nitroglycerine relieve the pain of patients suffering from angina pectoris?
  12. What is the product formed when you nitrate ethylene glycol with nitric acid?
  13. What are the health benefits of tea?
- 
-

## Answer guide to activities

1. The main steps of water purification are:  
Step 1- settling down suspended solids with  $\text{Al}_2(\text{SO}_4)_3$  and  $\text{Ca}(\text{OH})_2$   
Step 2- filter through sand and gravel  
Step 3- aerate by spraying into the air  
Step 4- charcoal filtration (if necessary)  
Step 5- chlorination
2. Health effects due to extent of dehydration are:  
1% reduction – feels thirsty  
5% reduction – muscle strength weakens  
10% reduction – confusion and blurred vision  
20% reduction – death
3. When the germ killing processes of the body take place at increased rates, in order to give protection against pathogens, the body temperature increases. This is known as fever.
4. Hypothermia develops when body's internal heat generation is not sufficient to balance heat lost to very cold surroundings.  
Unconsciousness usually results if the temperature drops below  $26^\circ\text{C}$ .
5. Junk food are fast food, which are easy to make and easy to consume. These are poor in nutrition. Regular consumption of junk food might cause cancer, hyperactivity, and obesity. Obesity in turn can cause many other health complications such as cardiovascular diseases, high cholesterol, diabetes, strokes, sleep apnea, etc.
6. The compounds containing two or more fused benzene rings.
7. Phenol,  $\text{NaOCl}$ ,  $\text{Ca}(\text{OCl})_2$
8. Refer section 11
9. Refer section 8

10.
  - (i) Wheezing and breathlessness
  - (ii) Salbutamol
  - (iii) It dilates the airways
  
11. It relaxes cardiac muscles and causes a dilation of the arteries, thus increases the blood flow to the heart and relieve pains.
  
12. Nitroglycerine
  
13. Flavonoids present in tea reduce fat deposits on walls of arteries that pump blood to the heart. It also increases the production of NO that contributes towards the relaxation of blood vessels, and makes it easier for the blood to flow through the body.



## Study Questions

1. What is the role of  $\text{Al}_2(\text{SO}_4)_3$  and  $\text{Ca}(\text{OH})_2$  in terms of water purification.
2. Explain the importance of drinking plenty of water daily.
3. Describe health effects due to variation in body temperatures.
4. Write a short account on aspirin.
5. What is meant by “antiseptic”?
6. Explain the role of anesthetics.
7. Explain medicinal aspects of aspirin, paracetamol, and salbutamol.
8. What is the product formed when you react salicylic acid with acetic anhydride?
9. How does nitroglycerine relieve the pain of patients suffering from angina pectoris?
10. What is the product formed when you react methanol with nitric acid?
11. What is the product formed when you react aniline ( $\text{PhNH}_2$ ) with acetyl

## References

1. Understanding chemistry for advanced level, T. Lister and J. Renshaw, 1991, Stanely Thornes (Publishers) Ltd.
2. Chemistry and our world, C. G. Gebelein, 1997, Wm. C. Brown Publishers.
3. Advanced Chemistry, P. Matthews, 1992, Cambridge University press.
4. General Chemistry Selected Topics, J. W. Hill and R. H. Petrucci, 1996, Prentice Hall.
5. Chemistry in Context, L. P. Eubanks, C. H. Middlecamp, N. J. Pienta, C. E. Heltzel, G. C. Weaver, 5<sup>th</sup> Edition, 2006, McGraw-Hill.
6. Chemistry for today, S. L. Seager and M. R. Slabaugh, 2<sup>nd</sup> Edition, 1994, West Publishing Company.

## Course Team

### Author

Professor K. Sarath D. Perera  
Senior Professor in Chemistry

### Content Editor

Ms. Chandani Ranasinghe  
Lecturer in Chemistry/OUSL

### Language Editor

Mrs. Nirmalie Kannangara

### Desk Top Publishing

Miss. K. K. H. De Silva  
Mr. R. M. Wimal W. Wijenayake

### Graphic Artists

Miss. K. K. H. De Silva  
Mr. R. M. Wimal W. Wijenayake

### Word Processing

Miss. K. K. H. De Silva  
Professor K. Sarath D. Perera

### Web Content Developers

Miss. Hashika Abeysuriya  
Miss. L. Melani Silva

### Cover Page Designing

Professor K. Sarath D. Perera  
Mr. R. M. Wimal W. Wijenayake

The Open University of Sri Lanka  
Nawala, Nugegoda, Sri Lanka

First published 2012

**ISBN: 978-955-23-1351-6**

