CARBOHYDRATES

The Carbohydrates includes simple sugars and poly saccharides. They are carbonyl alcohols containing the element Carbon, Hydrogen, And Oxygen. The last two elements are usually present in some proportion as in water. Carbohydrates are the primary product of photosynthesis and form them the plant synthesizes various chemical constituents by subsequent organic reactions. They are most abundant component of both plants (cellulose, starch, sugar) and animals (glycogen). Sugar are united with many compounds to form glycosides.

- Group of compounds composed of carbon, oxygen, and hydrogen

Examples: (Ch_2o) Hydrates of carbon

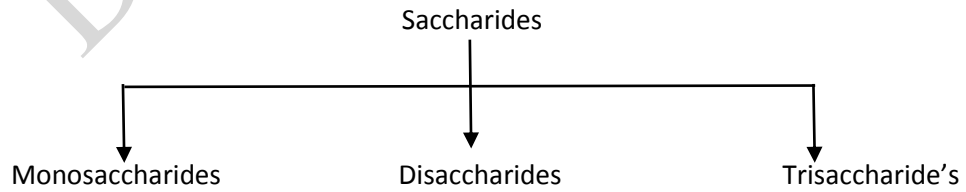
(Ch_3COOH) Acetic Acid

(CH_3-CHOHCOOH) Lactic Acid

- It is defined as polyhydroxy aldehydes or polyhydroxy ketones that on hydrolysis produce either of the above.
- They are substance of universal occurrence and are much abundant in plant, rather than in animals.
- Carbohydrates are divided into Two parts

Simple sugar (Saccharides) Polysaccharides

A. Simple Sugar: - (low molecular weight, less energy produce)
   It is crystalline soluble in water, Sweet in taste
   e.g. Glucose, Fructose, and Sucrose
B. Polysaccharides (High molecular weight t and also more energy produce)
   It is amorphous, tasteless & relatively less soluble in water.
   e.g. Starch, Cellulose, Gums, Pectin



a) Monosaccharides: -
   It has sugar, which cannot be further hydrolyzed to simple sugar.
   e.g. Bioses
   Trioses
   Tetroses
   Pentoses

b) Disaccharides: -

Which upon hydrolysis two molecules of monosaccharides are called as disaccharides.

e.g. Sucrose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Fructose

Maltose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Glucose

Lactose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Galactose

c) Trisaccharide: -

As the name indicates, these liberates 3 molecules of monosaccharides on hydrolysis.

e.g. Raffinose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Fructose + Galactose

Gentionose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Glucose + Fructose

❖ Polysaccharides: -

- When hydrolysis they give an indefinite no. of mono saccharides.
- By Condensation $\xrightarrow{\text{Elimination}}$ water
- Polysaccharides are produced from monosaccharides.

CHEMICAL TESTS FOR CARBOHYDRATES

1. ***Fehling's Solution test:***
   The substance is heated with dil. HCl to hydrolyzed a polysaccharide. The reaction mixture is neutralized by addition of sodium hydroxide solution and then Fehling's solution 1 & 2 is added. Red precipitate of cuprous oxide is produced on heating in case of reducing sugar (all monosaccharides and many disaccharides like lactose, maltose, cellobiose and gentiobiose) Non reducing sugars including some disaccharides (sucrose & trihalose) which on boiling with acid are converted into reducing sugars.
2. ***Molisch Test:***
   A solution of carbohydrates is prepared in water containing α-naphthol. On addition of conc. H_2SO_4 Along with the side of test tube a purple ring is formed on the junction blew aqueous layer. With insoluble carbohydrates (e.g. Cellulose) the color is produced on shaking the reaction mixture.
3. ***Osazone Formation:***
   A sugar on heating with phenyl hydrazine HCL, sodium acetate, and acetic acid forms yellow crystal of osazone.
4. ***Test for pentose:***
   A solution of material is heated with aqueous volume of HCl containing a little phloroglucinol. A red color is formed in case of pentose.
5. ***Keller Kiliani test for Deoxy sugars:***
   A deoxy sugars (found in Cardiac Glycosides) is dissolved in acetic acid containing a trace of ferric chloride and transferred to the surface of conc. H_2SO_4. A reddish-brown color is formed at the junction which turns blue latter on.
6. ***Furfural Test:***
   A carbohydrates sample is heated in a test tube with a drop of syrupy phosphoric acid to convert it into furfural. A disk of filter paper moistened with a drop of 10% solution of aniline in 10 % acetic acid is placed over the mouth of the test tube. the bottom of the test tube is heated for 30-60 Seconds. A pink or Red stain appears on the reagent paper.

Agar

Synonyms:
Agar-agar, Japanese isinglass.
Biological source:
Agar is the dried, hydrophilic, colloidal polysaccharide complex extracted from [Gelidium Cartilagineum L.]
Family: Gelidiaceae
Geographical source:
Agar is obtained mainly from Japan, Korea, South Africa, U.S.A., China, Indonesia, Australia and India.
Chemical Constituents:
On hydrolysis agar yields galactose and subplate ions obtained. It is heterogenous polysaccharides, agarose, responsible for gel strength.
It also contains L-Galactose and D- Galactose.
Uses:
1. It is uses as a bulk laxative (an agent to induce active movement of the bowels) and in chronic constipation (unmanageable constipation). Generally, it is given in combination with other Anthraquinones vegetable drugs.
2. In the preparation of vaginal capsules and suppositories (a cone shaped capsule like structure with the medicine in it, to be introduced into rectum, urethra or vagina).
3. To prepare nutrient media in bacteriological culture.
4. In industrial applications like emulsion, sizing, silk textiles, adhesives and thickening ice cream.

Guar Gum

Synonyms:
Guar Flour, Jaguar, Jaguar gum
Biological source:
Guar gum obtained from the refined endosperm of the seeds of [Cyamopsis tetragonolobus L] Taub.
Family: Leguminosae.
Geographical source:
It is commercially grown in India, Pakistan, and U.S.A. and to limited extent in South Africa, Brazil and Australia. In India, Rajasthan is the major guar-gum growing state.
Description:
i. Colour white or yellowish white free flowing powder.
ii. Odour odourless.
iii. Taste Characteristic.
iv. It is soluble in cold and hot water and forms neutral colloidal solution.
v. Guar gum is insoluble in alcohol, oils hydrocarbons, ketone, etc. Guar gum contains much thickening capacity than that of starch.

Chemical constituents:

i. Carbohydrate

ii. Gum- Guaran, the water-soluble portion of the gum and yields on hydrolysis galactose 35% and mannose 60-65%.

iii. Small quantity of protein.

Uses:

1. Protective colloids.
2. Used as binding agent and disintegrating agent in tablet formulations.
3. In bulk laxatives.
4. As appetite depressant.
5. It is used in peptic ulcer therapy.
6. It is also reducing blood glucose concentration in diabetic patients and serum concentration in hyper lipidaemia.
7. It is a good emulsion stabilizer.

Acacia

Synonyms:

Gum Arabic, Gum acacia, Babul and Gondu.

Biological source:

It consists of the dried gummy exudation obtained from the stem and branches of Acacia arabica Wild]. (Acacia Senegal)

Family: Leguminosae.

Geographical source:

It is found in Sudan, India, Morocco, Sri Lanka and Africa.

Chemical constituents:

i. Polysaccharide Arabin (Mixture of calcium, magnesium and potassium salts of arabic acid).

ii. Arabic acid on hydrolysis gives D-galactose, L-arabinose, L-rhamnose and D-glucoronic acid.

iii. Also contain enzyme oxidase and peroxidase.

Uses:

1. Demulcent.
2. Emulsifying agent.
3. Suspending agent.
. Binding agent.
5. Used in inflammation of intestinal mucosa.
6. Used to cover inflamed surfaces such as bums, sore nipples, etc.
7. Used in the manufacture of adhesive and ink.

Honey

Biological source:

Honey is the saccharine liquid prepared from the nectar of the flowers by the hive-bee [Apis mellifica] and bees of other species of Apis.

Family: Apidae

Geographical source:

Honey is produces in certain parts of West Indies, California, Chile, Africa, Australia, and New Zealand and also in India.

Description:

(i) Honey is viscid, translucent, and white to pale yellow or yellow brown- coloured liquid. On keeping it crystals of glucose separate. Odour is pleasant and characteristic and taste is sweet.

(ii) The odour and taste depend on the flowers from which nectar is sucked.

(iii) Specific rotation of honey is +3° to -10° and total ash 0.1 to 0.8%.

Chemical constituents:

(i) Honey consists chiefly a mixture of dextrose and laevulose (70-80%) and water (14-20%). contains sucrose (1.2-4.5),

(ii) Dextrin (0.06-1.25%), volatile oil, pollen grains enzymes

(iii) Vitamins

(iv) Amino acids

(v) Proteins

(vi) Colouring matters, etc.

Uses:

1. Honey is used as nutritive.
2. Demulcent
3. Mild laxative.
4. It is used as an important component of linctuses and cough mixtures.
5. It is a sweetening agent.
6. It is used as antiseptic and bactericidal.
7. This is also used as a vehicle in Ayurvedic and Unani preparations.
8. As a pill recipients

Isapaghula

Synonyms

Ispaghula, Isapgol, Spogel seeds, Isabghol.

Biological source:

It consists of dried seeds of [Plantago ovata Forsk]

Family: Plantaginaceae.

Geographical source:

Plant is cultivated largely in Gujarat, Punjab, Southern Rajasthan, Maharastra and Karnataka. The variety P. psyllium Linn is cultivated in Spain, Cuba and France.

Chemical Constituents:

(i) Ispaghula seeds and husk contains 10-30% of hydrocolloids as mucilage.

(ii) Chemically, it contains pentosan and aldobionic acid, Rhamnose, arabinose and galactouronic acids are hydrolyzed products of mucilage.

(iii) Fixed oils and proteinsare also present in the drug.

Uses:

1. Demulcents (Soothing property).
2. It is use in treatment of chronic constipation.
3. It is used in chronic dysentery of amoebic and bacillary origin.
4. It is used in chronic diarrhea.
5. It is also used as a stabilizer in ice cream industry.
6. Recently, it is used in the preparation of creams, lotions, soft drink and candies also.

Pectin

Biological source:

Pectin is a carbohydrate and is present in the cell wall as the calcium salt or methyl ester in the middle lamina. These are obtained from the inner portion of the rind of citrus fruits like lemon, orange, etc. and vegetative matter like sunflower, papaya, guavas, mangoes, etc.

Geographical source:

U.S.A., India, Switzerland and other European countries. Preparation: Pectin present in the cell wall is insoluble in nature known as prospecting, when the fruit pulp is treated with dilute acid at 90°C and pH 3.5-4 for 30 minutes. The solution is filtered and alcohol is added to filtrate, pectin precipitates out. This is separated and dried under reduced pressure.

Description:

Pectin is available as coarse or fine powder. It is yellowish white in colour, taste is mucilaginous and odourless. With water it forms colloidal solution. It is mild acidic in nature. It is stable at slightly acid pH and depolymerisation takes place in strong acidic or basic conditions.

Chemical constituents:

(i) Chemically pectins are polygalacturonic acids in which some of the carboxyl groups are present as methyl esters.

(ii) Pectic acid is an aldobionic acid, which on hydrolysis gives galacturanic acid, arabinose, galactose, and methyl pectose.

(iii) Pectin is a methoxy ester of pectic acid. It is hydrolysed by pectase of dilute caustic soda, produce pectic acid and methyl alcohol, component of pectin and cellulose. It is insoluble in water.

(iv) Alkaline hydrolysis of pectose forms pectin and cellulose.

Uses:

1. It is used in the treatment of diarrhea and gastroenteritis.
2. It is used in the treatment of wounds (2% sterile solution).
3. As a substitute for blood plasma.
4. In conjugation with kaolin as an absorbent of intestinal toxins. .
5. To dampen and mask the taste

Starch

Synonyms:
Amylum.
Biological source:
Starch consists of polysaccharide granules obtained from the grains of Maize [Zea mays L], or of rice [Oryza sativa L] or of wheat [Triticum aestivum L].
Family- Graminae
Geographical source:
Starch is commercially produced in tropical and subtropical countries. Argentina, U.S.A, China, India and Japan are the main starch producing countries of the world.
Chemical constituents:
(i) Starch contains generally a mixture of two polysaccharides, amylopectin (α- amylose) and amylose (β-amylose).
(ii) Amylopectin it is the main constituent of most of the starches (more than 80%) and is present in outer parts of granules. It contains both strait chained and branched glucose unit. It is insoluble in water and is responsible for gelatinizing property. It gives bluish black colour with iodine solution.
(iii) Amylose most starches contain 20% amylose. It contains straight chained glucose units and is present in inner parts of granules. It is soluble in water and produces blue colour with iodine solution.
Uses:

1. It is mainly used as a dusting powder.
2. As a Pharmaceutical aid.
3. Used as an antidote for iodine poisoning.
4. Source of Food-nutrition.
5. Protective and demulcent.
6. In paper-sizing and textile industry and in laundry practice etc.
7. It is the starting product form which liquid glucose, dextrose, dextrin are made.
8. Acts as a basis for identification of drugs in Pharmacognosy.
9. It is also used as a tablet disintegrating agent and diluents.

Tragacanth

Synonyms:
Gum Tragacanth, Hindi.-Anjira.
Biological source:
Tragacanth is dried gummy exudation obtained from the stem of [Astragalus gummifer Labill].
Family: Leguminosae.

Geographical source:
It is a native of Southern and Eastern Europe. The plant is widely distributed in Iran, Afghanistan, Iraq, Syria, Anatolia and India. In India, few species of Astragalus are available in Garhwal, Shimla, and Kashmir and Hilly region of Kumaon.

Macroscopical characters:
(i) Form-flattened, lamellate, tough ribbon shaped pieces of horny structures, more or less curved or contorted
(ii) Colour-white or faint yellow
(iii) Size-about 2.5 cm length
(iv) Facture-Short
(v) Odour-None

Chemical constituents:
It contains a complex polysaccharide carbohydrate.
a. Water-soluble Tragacanthin (30-40%)
b. Water insoluble Bassorin (60-70%)
Tragacanth in turn consists of (a) tragacanthic acid + (galacturonic acid + xylose + fructose + galactose) and (b) Arabinogalactan + (arabinose + galactose + galacturonic + Rhamnose in small quantities). It is also contains 3% starch and cellulose.

Uses:
1. It is used as a demulcent (soothing).
2. Suspending agent.
3. Binding agent.
4. Emulsifying agent.
5. Laxative.
6. It is used in adhesive
7. In textile industry.

Sterculia Gum

Synonyms:
Kadaya, Kullo, Gum Karaya, Karaya Gum

Biological source:
Sterculia is the dried gummy gummy exudate of the tree [Sterculia Urens Roxb]

Family: Sterculiaceae.

Geographical source:
The tree is found in Pakistan and South Africa, in India (Guajrat, Maharastra, Madras, Rajasthan M.P. and Chota Nagpur

Chemical constituents:
Sterculia gum consists heteropolysaccharide with a high composition of D-galacturonic acid and D-glucuronic acid

Uses:
1. Bulk Laxative
2. Emulsifying and suspending agent
3. Dental adhesives
4. Used in skin lotions, textiles and printing industries.

Beeswax

Synonyms

Bees wax; Cera-flava; Ben. And Hin.- Mom; Guj.- Min.; Kan.- Mena.

Biological source:

Yellow bees wax is purified wax and obtained from the honey comb of the bees [Apis mellifera] and other species of Apis.

Family: Apidae.

Geographical source:

It is prepared in California, Africa, France, Italy, West Africa and India.

Preparation:

Combs and capping of honey comb is kept in boiling water, for melting. The water-soluble impurities are dissolved and other impurities sinks in the water. On cooling, the melted wax gets solidity and floats on the water surface. Wax is removed and process is repeated several times to get pure yellow beeswax. This is bleached with charcoal, potassium per-magnate, chlorine, ozone, chromic acid or hydrogen peroxide to obtained white beeswax. Natural bleaching is done by exposing thin layer of yellow beeswax to sun light.

Description:

(i) Colour – White or Yellow
(ii) Odour – honey like
(iii) Taste – Waxy
(iv) Fracture – brittle and granular
(v) Solubility – Soluble in chloroform, ether and in both essential and fatty oils, but insoluble in water

Chemical constituents:

(i) Lipids like wax- myricyl palmitate (80%).
(ii) Wax -acid such as cerotic acid (15%).
(iii) Aromatic substances: Cerolein.
(iv) Cholesteryl ester.

Uses:

- As a pharmaceutical aid.
- It is used in the preparation of plasters, ointments and polishes.
- It is used in ointment for hardening purpose and in the manufacture of candles,
- Moulds and in dental and electric industries.
- It is also used in cosmetic for the preparation of lip-sticks and face creams.

Castor Oil

Synonyms

Ben. – Bherenda; Guj. – Diveli; Hindi- Erand; Kan. – Haralenne.

Biological source:

Castor oil is the fixed oil obtained by cold expression from the seeds of [Ricinus communis L].

Family: Euphorbiaceae.

Geographical source:

India and other tropical and subtropical countries

Characters:

(i) Colour – Colourless or pale yellow.
(ii) Nature – Viscid liquid
(iii) Odour – Faint
(iv) Taste – Acrid and nauseating;
(v) Solubility – Soluble in alcohol in all proportions, chloroform and solvent ether.

Chemical constituents:

i. Lipids- Fixed oils (45-55%).
ii. A mixture of triglyrides.
iii. Triricinolein (75%), which on hydrolysis yields ricinoleic acid responsible for the cathartic effect.

Uses:

- Cathartic (increases the movement of the bowels)
- In soap industry.
- As a lubricant.
- Castor oil is used as plasticizer and in preparation flexible collodion.

Cocoa butter

Synonyms:

Theobroma oil; Cacao butter

***Biological* source:**

It is obtained from roasted seeds of [Theobroma cacao L].

Family: Sterculiaceae.

Geographical source:

Gold Coast, Nigeria, Brazil, Ecuador, Ceylon, and British, West Indies, Mexico, Sri Lanka, India

Description:

(i) Colour – yellowish-white solid.
(ii) Odour – Pleasant chocolate;
(iii) Taste – pleasant;
(iv) It is insoluble in water, but soluble in ether, chloroform, benzene and petroleum ether.

Chemical constituents:

It contains of glycerides of stearic acid (34%), oleic acid (37%), Palmitic acid (25%), and small quantity of arachidic acid and linoleic acids. The non-greasiness of product is due to its glycerides structure.

Uses:

- Used as a base for suppositories and ointments,
- Manufacture of creams and
- Manufacture toilet soaps.

Cod Liver Oil:

Synonyms:

Oleum morrhi

Biological source:

It is processed from fresh liver of cod fish, [Gadus morrhua] and other species of Gadus.

Family: Gadidae

Geographical source:

They are prepared in Scotland, Iceland, Germany, Denmark and Britain.

Description:

Colour – Pale yellow thin liquid

Taste – Slightly fishy

Odour – Fishy

It is freely soluble in chloroform, ether, carbon disulphide, and petroleum ether and slightly soluble in alcohol.

Chemical constituents:

i. It contains of vitamin A and D.

ii. The oil contains glyceryl ester of oleic, linoleic, gadoleic, myristic. Palmitic and other acids.

iii. Cod liver oil also contains 7% eicosapaenoic acid and docosahexanoic acid.

Uses:

- The oil is used as source of vitamins
- As a nutritive
- Treatment of Rickets and Tuberculosis.

Hydnocarpus Oil

Synonyms:

Chaulmoogra oil, Gynocardia oil

Biological source:

Chaulmoogra oil is the fatty oil obtained by cold expression from the fresh ripe seeds of [Hydnocarpus anthelmintica].

Family: Flacourtiaceae.

Geographical source:

It found in East India, Burma, Thailand and Indochina.

Characters:

- Colour – Yellow or brownish yellow.
- State – below 25° a white soft solid;
- Odour – Characteristic, somewhat similar to that of rancid butter;
- Taste – Acrid.

Chemical constituents:

Mixture of glycerides

i. Fatty acid
ii. Hydnocarpic acid:
iii. Chaulmoogric acid
iv. Gorlic acid

Uses:

- It is used in the treatment of tuberculosis.
- Leprosy.

Kokum Butter

Synonyms:

Goa butter, kokum oil, Mangisteen oil

Biological source:

It is fat expressed from the seeds of [Garcinia indica]

Family: Guttiferae

Geographical source:

Thailand, Cambodia, China India

Chemical constituents:

- Glycerides of stearic (55%),
- Oleic (40%),
- Hydroxy capric acid (10%).

Uses:

- It is used as nutritive, demulcent astringent.
- locally it is used in fissures of lips and hand.
- It is used in the preparation of ointments and suppositories.

Lard: Sources

Synonyms:
Adeps.
Biological source:
It is purified internal fat obtained from the abdomen of the Hog [Sus Scrofa Linn]
Family: Suidae.
Description:

- Colour – white, homogenous fatty mass unctuous to rough;
- Odour – slight;
- Taste – bland;
- It is insoluble in alcohol and in benzene, carbon disulphide, ether and chloroform.

Chemical constituents:

i. Olein
ii. Stearin
iii. Palmitin.

Uses:

- It is used as an ointment base and in formulations where more effective absorption is desired.
- Benzoinated lard contains benzoin resin as preservative.

LINSEED OIL

Synonyms*:*
Flax seed, alsi (Hindi).
Biological Source*:*
Linseed is the dried, ripe seed of [Linum usitatissimum Linn]. Linseed oil is obtained by expression of linseeds, belonging to
Family*:* Linaceae.
Geographical Source*:*
Linseed is cultivated in many sub-tropical countries such as South America, India, United States, Canada, England, Russia, Greece, Italy, Spain, and Algeria.
Chemical Constituents*:*
Linseed contains fixed oil (30–40%), mucilage (6–10%), protein (25%) (linin and colinin), small amount of enzyme lipase, and linamarin which is a cyanogenetic glycoside. The carbohydrates present are sucrose, raffinose, cellulose, and mucilage.
Uses*:*
Linseed is used as demulcent and in form of poultices for gouty and rheumatic swellings. Internally it is used for gonorrhoea and irritation of the genito-urinary system.
Linseed oil has emollient, expectorant, diuretic, demulcent, and laxative properties

Nonstaining iodine ointment soap, linoleum, greases, polishes, polymers, varnishes, paints, putty, oil cloths, printing inks, artificial rubber, tracing cloth, tanning and enamelling leather, etc. are also prepared from Linseed oil. The mucilaginous infusion is used internally as a demulcent in colds, coughs, bronchial affections, inflammation of the urinary tract, gonorrhoea, and diarrhoea.

Rice Bran Oil

Synonyms:
Rice oil.
Biological source:
Rice bran is the cuticle existing between the rice and the husk of the paddy and consists of embryo (germ) and endosperm of the seeds of [Oryza sativa]. It is obtained as a byproduct in rice mill during polishing of rice obtained after de-husking of paddy.
Family: Graminae.
Description:
It is golden yellow oil difficult to bleach, and not affected by temporary heating to 160°C. It is insoluble in water but soluble in organic solvent.
Chemical constituents:

1. **Fatty acid:**
    i. Oleic acid
    ii. Linoleic acid.
    iii. Palmitic acid.
2. **Squalene.**
3. **Tocopherol.**

Uses:

- Antioxidant.
- Emollient.
- Manufacture of cosmetics.
- Preparation of vegetable ghee.

Shark Liver Oil

Synonyms:
Oleum Selachoids.
Biological source:
Shark liver oil is obtained from the fresh or carefully preserved livers of the shark [Hypoprion brevirostris]. It contains in 1 g not less than 6000 international Units of Vitamin A activity.
Family: Carcharhinidae
Geographical source:
In India, the shark livers are processed and oil is obtained on commercial scale in Tamil Nadu, Maharashtra, and Kerala, European countries.
Description:

- Color – Pale yellow to brown yellow
- Odour – fishy
- Taste – Fishy and bland;
- Solubility – Miscible in light petroleum (50-60°), ether, chloroform and slightly soluble in alcohol.

Chemical constituents:
Vitamin A and glycerides of saturated and unsaturated fatty acids. The concentration of Vitamin A ranges from 15000 to 30000 units per gram.
Uses:

- Source of vitamin A.
- In the treatment of xerophthalmia (abnormal dryness of the surface of the conjunctiva)
- In combination with vitamin D, it is given as a tonic and nutritive in cases of TB. It is used in burn and sunburn ointments.

Storage:
Preserve shark liver oil in a well-filled, well closed container, protected from light.

Wool Fat

Synonyms:
Adeps Lanae, Lanolin
Biological source:
Hydrous wool fat is the purified fat like substance obtained from the wool of [Ovries aries Linn]
Family: Bavidae
Geographical source:
Lanolin is commercially manufactured in Australia, U.S.A. and also in India
Chemical constituents:
It content mainly esters of cholesterolsand iso cholesterol with caranubic oleic, myristic, palmitic, and lanopalmitic acid
Uses:

- Used as water absorble oinment base.
- Used as a common ingriient and base of water soluble creams and cosmetics,