INTRODUCTION

Pharmacology (derived from Greek words, pharmacon-drug; logos-discourse in) consists of detailed study of drugs – its source, physical and chemical properties, compounding, biochemical and physiological effects, pharmacodynamics (its mechanism of action), pharmacokinetics (absorption, distribution, biotransformation and excretion), therapeutic and other uses of drugs.

According to WHO definition ‘Drug is any substance or product that is used or intended to be used to modify or explore physiological system or pathological states for the benefit of the recipient’.

Pharmacology has some major subdivisions:

**Pharmacodynamics** is the study of the biochemical and physiological effects of the drugs and their mechanism of action.

**Pharmacotherapeutics** deals with the use of drugs in the prevention and treatment of diseases and it utilizes or depends upon the information of drug obtained by pharmacodynamic studies.

**Pharmacokinetics** deals with the alterations of the drug by the body which includes absorption, distribution, binding/storage, biotransformation and excretion of drugs.

**Toxicology** deals with the side/adverse effects and other poisonous effects of drugs, since the same drug can be a poison, depending on the dose.

**Chemotherapy** deals with the effects of drugs upon microorganisms and parasites without destroying the host cells.

Pharmacology also includes certain allied fields as:

**Pharmacy** is the science of preparation, compounding and dispensing of drugs. It is concerned with collection, identification, purification, isolation, synthesis and standardization of medicinal/pharmaceutical substances.

**Pharmaceutics** deals with the manufacture of drugs and pharmaceuticals.

**Pharmacognosy** deals with the study of the sources of drugs derived from plants and animal origin.

**Materia-medica**: This is an older term and deals with the source, description (physical and chemical properties) and preparation of drugs.

**Pharmacopoeia** is an official reference containing a selected drugs/medicinal preparations with their description, tests for their identity, purity and potency and with their average doses. A few famous pharmacopoeia and other reference books are the Indian Pharmacopoeia (IP), the British Pharmacopoeia (BP); the United States Pharmacopoeia (USP); the British Pharmaceutical Codex (BPC); the National Formulary (NF) i.e. British National Formulary (BNF) and National Formulary (NF) of India.
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SOURCES OF DRUGS

‘Drug’ is derived from French word ‘drogue’ means a dry herb. Drugs are obtained mainly from plants, animals, microbes and mineral sources, but a majority of them that are used therapeutically are from synthetic or semi-synthetic products.

Plant Origin

The pharmacologically active components in vegetable drugs are:

i. Alkaloids are basic substances containing cyclic nitrogen. The important alkaloids are obtained from:
   - Opium (Papaver somniferum): Morphine group.
   - Cinchona (Cinchona officinalis): Quinine etc.
   - Belladonna (Atropa belladonna): Atropine group.
   - Pilocarpus sp.: Pilocarpine.
   - Vinca (Vinca rosea): Vincristine, vinblastine.
   - Rauwolfia serpentina (root): Reserpine.
   - Coca (Erythroxylum coca): Cocaine.

ii. Glycosides are ether like organic structure combined with sugars, the non-sugar component called aglycone or genin. The important glycosides are:
   - Digitalis (Digitalis purpurea, Digitalis lanata): Digoxin etc.
   - Stropanthus (Stropanthus kombe): Strophanthin etc.
   - Senna (Cassia acutifolia): Sennoside etc.

iii. Oils
   a. Fixed oils are glycerides of oleic, palmitic and stearic acids. Mostly fixed oils are edible and used for cooking. The fixed oils used as drug are:
      - Castor (Ricinus communis): Castor oil.
      - Olive (Olea europaea): Olive oil.
      - Cocoa butter (Theobroma cacao): Theobroma oil used as emollient in skin cream and making suppositories.
   b. Volatile oil or essential oil contains the hydrocarbon terpene. The important volatile oils are:
      - Turpentine oil, from species of pines, used as a counter-irritant.
      - Lemon oil (from Citrus limon), used as flavouring agent.
      - Peppermint, cardamom and fennel used as carminative and flavouring agent.
      - Oil of clove is mainly useful in relieving pain in toothache.

iv. Resins are produced by oxidation and polymerization of volatile oils. The different types of resins are:
   - Oleoresins: Male fern extract used for tapeworm infestation.
   - Gum resins: Asafoetida, used as carminative and antispasmodic.
   - Oleo gum resin: Myrrh, it has a local stimulant and antiseptic properties and generally used in mouthwash.
   - Balsams: Benzoin, used internally as expectorant and externally as astringent.
   - Balsam Tolu, used as stimulating expectorant.

v. Gums are the secretory products of plants. On hydrolysis, they yield simple sugar like polysaccharides. They are pharmacologically inert substances and mainly employed as suspending and emulsifying agent in various pharmaceutical products. The widely used preparations are gum acacia and tragacanth.

vi. Tannins are nonnitrogenous constituents of plant. Chemically they are phenolic derivatives and are characterized by their astringent action. Tannins are generally employed in the treatment of diarrhoea and burns. The important plants which contains tannins are: Amla, Behera, Hirda (in combination form ‘Triphala’), Black catechu and Ashoka bark.
General Action of Drugs

Animal Sources
The different animal products after purification in a suitable dosage form for the treatment of disease are listed in table 1.1.1.

From Human Being
There are certain products which are obtained from human being e.g.
- Immunoglobulins: From blood.
- Placental extract: From placenta.
- Chorionic gonadotropin: From urine of pregnant women.
- Growth hormone: From pituitary gland.

From Microorganisms
The different classes of drugs obtained/isolated from microbes are:
- Penicillin: *Penicillium chrysogenum* and *notatum* (Fungus).
- Streptomycin: *Streptomyces griseus* (Actinomycetes).
- Erythromycin: *Streptomyces erythreus* (Actinomycetes).
- Chloramphenicol: *Streptomyces venezuelae* (Actinomycetes).
- Tetracyclines: *Streptomyces aureofaciens* and *rimosus* (Actinomycetes).
- Polymyxin B: *Bacillus polymyxa*.
- Bacitracin: *Bacillus subtilis*.
- Nystatin: *Streptomyces noursei*.
- Griseofulvin: *Penicillium griseofulvum*.

Apart from various other antibiotics obtained from microorganisms, there are other products that are also produced by microorganisms. They are:
- Streptokinase, an enzyme from gram positive cocci (*Streptococcus pyogenes*).
- Vitamin $B_{12}$ (cyanocobalamin): *Streptomyces griseus*.

ROUTES OF DRUG ADMINISTRATION
The drugs can be administered by a variety of routes, either locally or administered orally and by injection. To produce local effects, drugs are applied topically to the skin or mucous membranes. To produce systemic effects drugs are administered orally, rectally, parenterally or by inhalation route.

The choice of the route in a given situation depends upon the drug and the patient’s condition (e.g. in unconscious and vomiting state), and urgency of treatment (whether the routine treatment or in emergency condition).

The important routes of administration are:

Local Routes
The dosage forms applied locally to the skin are powders, paste, lotions, ointments, creams, plasters and jellies. They are used for their antiseptic, antipruritic, analgesic, local anaesthetic and other related effects.

The absorption of drug through the skin is proportional to the surface area covered and to

<table>
<thead>
<tr>
<th>Drug</th>
<th>Category</th>
<th>Animal source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin</td>
<td>Hormone</td>
<td>Pancreas of beef or pig</td>
</tr>
<tr>
<td>Thyroid extract/thyroxine</td>
<td>Hormone</td>
<td>Thyroid gland</td>
</tr>
<tr>
<td>Shark liver oil</td>
<td>Vitamin A</td>
<td>Livers of shark and allied species</td>
</tr>
<tr>
<td>Cod liver oil</td>
<td>Vitamin A and D</td>
<td>Livers of Gadus species</td>
</tr>
<tr>
<td>Antisnake venom</td>
<td>Immune serum</td>
<td>Blood of horse</td>
</tr>
<tr>
<td>Hyaluronidase</td>
<td>Enzyme</td>
<td>Testis of bull</td>
</tr>
<tr>
<td>Pepsin</td>
<td>Enzyme</td>
<td>Stomach of beef and pig</td>
</tr>
<tr>
<td>Surgical ligatures and sutures</td>
<td>Used in surgery</td>
<td>Intestinal tissues, tendons of animals.</td>
</tr>
</tbody>
</table>
their lipid solubility. The dermis layer is freely permeable to many fluids. Inflammatory and other related conditions which increase the cutaneous blood flow also enhance absorption of drugs. Absorption through the skin can be enhanced by induction (rubbing the oily vehicle preparation into the skin) also.

On the skin, drug is applied in the form of ointment, cream, lotion, paste, plaster, powder etc.

The topical application is also used on the mucous membranes i.e. nose, throat, ear, bronchi, rectum, urethra, vagina and rectum.

In case of mouth and pharynx, the drug is used in the form of throat paints, lozenges, gargles or mouth washes.

In case of corneal application (in the form of ointments, drops), the drug may penetrate the anterior chamber and affect the ciliary muscle. The nasal mucosa is treated with drug solution in the form of spray or irrigation.

The bronchial mucosa and lungs are treated with inhalations, aerosols (in the form of fine powder with the help of nebulizer) e.g. salbutamol (ASTHALIN) inhaler.

Drugs may also be administered locally in the form of bougies, jellies for urethra, pessaries, vaginal tablets, creams and douches for vagina and suppositories for rectal administration.

Due to the rich blood and lymph supply to rectum the unionised and lipid soluble substances are readily absorbed from the rectum. The advantages of this route are that gastric irritation is avoided and easy administration by the patient himself.

Administration of drug in the form of liquid into the rectum is called enema, which may be soap water or glycerine-vegetable oil. It is used to remove the faecal matter and flatus and is used in constipation. Certain drugs are administered rectally for producing systemic effects also (e.g. aminophylline, indomethacin, paraldehyde etc.).

**Systemic Routes**

The drug administered through systemic routes (orally or parenterally), is absorbed into the blood, distributed along through the circulation and produce their desired effects.

**Oral Route**

This is the most commonly used route for drug administration. It is also the safest, most convenient and economical. But, there are some limitation of this route:

- Drug action is slow, thus not suitable for emergencies.
- Incapability to absorb some drugs, due to their physical characteristics i.e. polarity of the drug.
- Unpalatable and other irritant drugs can not be administered.
- Can not be used for unconscious and uncooperative patient.
- May not be useful in the presence of vomiting and diarrhoea.
- Drugs, which can be destroyed by digestive juices (i.e. insulin, penicillin G) or in liver (i.e. testosterone, nitroglycerine) can not be administered orally.
- The absorption of certain drugs is negligible e.g. streptomycin.

**Enteric Coated Tablets**

The drugs which are destroyed by the gastric juices in the stomach, are coated with keratin, shellac and cellulose acid phosphate. These substances are not dissolved by the acid juice of the stomach, but are dissolved in the intestinal juice (alkaline) only, which is useful in:

- Preventing gastric irritation and alteration of the drug in the stomach.
- To get the desired concentration of the drug in intestine.
- To delay the absorption of the drug.

**Time Release/Sustained Release Capsules**

It is a useful solid dosage form of drug, where the
particles of the drug dissolve at different time intervals.

The advantages of time-release preparations are:
- Reduction in the frequency of administration of drug.
- Maintenance of therapeutic effect for longer time.
- To some extent decreased incidence of undesired effects.
- Appropriate for drugs with short half lives (less than 4 hours).

Sublingual Administration

The highly lipoid soluble and nonirritating drugs (i.e. nitroglycerine, isoprenaline, methyltestosterone) in the form of tablets or pellet is placed under the tongue, where they rapidly dissolve and are absorbed quickly in the general circulation. The advantages of this routes are:
- Rapid onset of action.
- The degradation and metabolism of the drugs in the stomach and liver is avoided.

Parenteral Routes
(par = beyond, enteral = intestinal)

The administration of drugs by injection directly into the tissue fluid or blood without having to cross the intestinal mucosa.

The advantages of parenteral routes are:
- Rapid action of drug.
- Can be employed in unconscious/uncooperative patients.
- Drugs, which are modified by alimentary juices and liver can be given by this route.
- Drugs, which are not absorbed in small intestine or irritate the stomach can be administered by this route.

Disadvantages are:
- Less safe, more expensive.
- Inconvenient (painful) for the patient.
- Self medication is difficult.
- Chances of local injury at the site of injection.

The important parenteral routes are:

Subcutaneous

The non-irritant substances can be injected by this route. The rate of absorption of drug is constant and slow to provide a sustained effect. The site of injection is usually the outer surface of the arm, or front of the thigh. Self medication (e.g. insulin) is possible because deep penetration is not needed. Other drugs which are administered subcutaneously are adrenaline, morphine and certain hormonal preparations.

The other related subcutaneous routes are dermojet (by which, drug is projected from a microfine orifice using a high velocity jet) and pellet implantation (which provides sustained release of the drug over weeks and months e.g. testosterone).

Intramuscular

The soluble substances, mild irritants and suspensions can be injected by this route in the large skeletal muscles (deltoid, triceps, gluteus maximus, rectus femoris etc.). These muscles are less richly supplied with sensory nerves and are more vascular, so irritant solutions can be injected. Small volumes (up to 2 ml) are injected into the deltoid muscle, and small or large volumes (up to 10 ml) are injected into the gluteal mass.

The rate of absorption is reasonably uniform and the onset of action is rapid.

Intravenous

The drug is injected as a bolus or infused slowly directly into a vein to produce rapid action. It is also useful for certain irritant and hypertonic solutions, as they are rapidly diluted by the blood. Drugs in an oily vehicle or those which precipitate blood constituents or haemolyze erythrocytes should not be given by this route.

Intravenous route is the most rapidly effective and the desired blood concentration can be obtained with a definite dose but at the same time it is the most dangerous route of administration. For once the drug is injected there is no retreat. So, intravenous injection must usually be
performed slowly and with constant monitoring of the patient. This route is usually reserved for emergencies when a rapid action is required and infusion of large amounts of fluids to overcome dehydration or to supply nutrition to patients who can not take food/fluids orally.

**Intradermal**

The drug is injected into the skin raising a bleb. This route is employed for vaccination e.g. BCG vaccine and for testing the sensitivity e.g. penicillin injection.

**Intra-arterial**

This route is useful in diagnostic studies, by which arterial blood sample may be withdrawn for blood gas studies. Certain cytotoxic compounds are administered by intra-arterial perfusion in localised malignancies.

**Intrathecal or Intraspinal**

For local and rapid effect of drugs on the meninges or cerebrospinal axis, drugs are injected directly into the spinal subarachnoid space. This is also used to produce spinal anaesthesia, or for introduction of a radio-opaque contrast-medium into the subarachnoid space for visualising the spinal cord.

**Intramedullary**

By this method, the drug is introduced into the bone marrow of the sternum or tibia. Blood is occasionally given by this route.

**Intracardiac**

In sudden cardiac arrest and other cardiac emergencies, the adrenaline is directly injected into the heart by a long needle in the left fourth intercostal space close to the sternum.

**Intraperitoneal**

This route is a common laboratory procedure, but it is seldom employed clinically in infants for giving fluids like glucose saline, as the peritoneum offers a large surface for absorption.

**Intra-articular**

Certain drugs (i.e. glucocorticoids) can be administered directly into a joint space for the treatment of local condition i.e. rheumatoid arthritis.

**INHALATION ROUTE**

The volatile liquids and gases are given by inhalation route. The drugs may be given as solid particles, as nebulized particles from solutions or in the form of vapours. The volatile substances include gaseous anaesthetics, amyl nitrite and vapours of liquid anaesthetics, gases like oxygen, carbon dioxide and helium.

Nonvolatile substances have to be broken down into small particles, and then inhaled as aerosols.

Drugs given by this route are quickly absorbed, which takes place from the vast surface of alveoli and produce rapid action. Various bronchodilators and mast cell stabilizers are used in the treatment and prophylaxis of bronchial asthma i.e. salbutamol (ASTHALIN) and sodium cromoglycate (FINTAL) inhaler.

**DOSAGE FORMS**

A dosage form is a medicated product specially designed for administering to the patient for the diagnosis and treatment of disease.

The dosage form is broadly divided into solid dosage form, liquid dosage form and inhalation which are used both internally as well as externally.

**Solid dosage form** includes capsules, granules, effervescent granules, powders, tablets, insufflations, suppositories (pessaries, bougies and ear cone) etc.

**Semisolid/liquid dosage form** includes elixirs, emulsions, gels, linctus, mixtures, drops, solutions, syrups, tinctures, applicators, creams, enema, gargles, jellies, liniments, lotions, mouth washes, ointments, paints, paste, poultices etc.

**Inhalation forms** include aerosols, sprays etc.
DOSAGE FORMS AND ROUTES OF DRUG ADMINISTRATION

A dosage form is a medicated product specially designed for administration depending upon the routes to the patient for the diagnosis and treatment of disease.

The dosage form is broadly divided into solid dosage form, liquid dosage form and inhalations which are used both internally as well as externally.

Solid Dosage Form (Internal Use)

Capsules: These are small gelatin contains shells. Capsules are of two type – hard & soft capsules.

Hard capsules are used for powdered drugs e.g. capsules ampicillin, tetracycline. In hard capsules, certain sustained released substance, which gradually release the drug in the respiratory tract (e.g. cap. theophylline).

Soft capsules are used for oils and solution of active drugs e.g. cap. vitamins A, A & D, E, garlic pearls, seven seas etc.

Soft capsules are also used for semisolid (ointment) e.g. eye applicaps of chloromycetin.

Granules: These are mixture of active medicament, sugar and some flavouring agent and then moistened to produce a coherent mass which is then passed through a sieve to form a granule. Granules are the unusual means of administering drug that possess an unpleasant taste e.g. PAS (para-amino salicylic acid) granules.

Effervescent granules: It is a mixture of citric and tartaric acids with sodium bicarbonate and usually some sweetening agents (saccharin or glucose) may be added.

The powder granules should be dissolved with a prescribed amount of water and taken when it produce effervescence e.g. ENO powder used for indigestion, flatulence and heartburn etc.

Powder: Powder are medicaments in dried form. The powders are of different types:

- Simple or compound powder: The simple powder contain just one active ingredient (e.g. acetylsalicylic acid powder) and compound powder contain more than one active ingredient.
- Powders enclosed in cachets (e.g. ALCOPAR, ORS powder) and in capsules (e.g. ampicillin powder).
- Effervescent powder.
- Powder for external use e.g. NEBASULF; boric acid powder, zinc oxide powder, talc etc. Tooth powder may also be classified under this group.
- Powder with metal (e.g. mercury with chalk) used as purgative.
- Powder use after reconstitution e.g. syr. ampicillin for paediatric use.

Tablets: These are the most extensively used solid dosage form containing granulated or powdered drugs that are compressed or moulded into different shapes. These are different types of tablets according to their size, shape and uses:

- Simple tablets:
  - Are disintegrated readily e.g. tab aspirin.
- Soluble tablets:
  - Are dissolved in water to form solution for internal and external use (gargles) e.g. tab Disprin.
  - Also used for parenteral administration called hypodermic tablets e.g. atropine sulphate tablets.
- Scored tablets:
  - They may be easily divided if smaller doses are required (e.g. tab Analgin).
- Lozenges:
  - Are solid preparation consisting mainly of sugar and gum and ensures slow release of medicaments and generally used for local action e.g. cough remedies – Strepcils, Vocacil.
- Pastilles:
  - Are solid medicated preparation intended to
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• Dissolve slowly in the mouth and softer than lozenges.
  - Chewable tablets:
    - Are chewed in the mouth for systemic action e.g. tab. Digene, vitamin C (Suckoe), mebendazole (for paediatric use) etc.
  - Buccal or sublingual tablets:
    - Are chewed and placed under the tongue. When it dissolved and exert their action e.g. tab. nitroglycerine.
  - Implants:
    - Are tablets use for sustained action and implanted under the skin e.g. Deoxycortone acetone (for contraception).
  - Depot tablets:
    - Are compressed tablets used for sustained systemic action e.g. tab. Asmapax Depot for asthmatic patients.
  - Enteric-coated tablets:
    - Are coated with keratin, cellulose acetate phthalate, which do not dissolve in the stomach and only dissolve in alkaline juice of the intestine where the drug is liberated e.g. tab. erythromycin.

Solid Dosage Form (Externally used)

Collodions: These are the fluid preparation intended for external use. The vehicle of collodion are volatile (e.g. ethyl alcohol) in nature and when applied on the skin (with brush or rod) evaporates to the skin and leaving a flexible, protective film. The film producing agent is pyroxylin (nitrocellulose) and for flexibility colour oil is added.

It is generally used for small cuts and abrasions.

Dusting powder are free flowing and very fine in nature for external use.

Insufflations are dusting powder consisting medicaments that are blown by an insufflator (similar to atomiser) into various body cavities, nose, throat, ear etc., where it would be difficult to apply the powder directly.

Suppositories are conical or ovoid shape solid preparation made up of fat (cocoa butter oil or theobroma oil), a wax or a glycerine-gelatin jelly. They are used for insertion into the rectum, where they melt, dissolve and disperse and exert their action – local as well as systemic.

Pessaries are the same as suppositories for introduction into vagina. Pessaries are of two type:
  - Moulded pessaries (as suppositories).
  - Compressed pessaries – in different shapes.

Bougies are used for nasal and urethral administration of drugs.

Ear cone for administration of drugs in ear.

Plasters are solid adhesive (with cloth) preparation applied to the skin to protect, soothe and lessen pain e.g. Mustard plaster, Capsicum plaster.

Semisolid/Liquid Dosage Form (Internal Use)

Aqua are aqueous solution of volatile substance used as solvent in certain pharmaceutical preparation to mask the disagreeable taste of drug e.g. peppermint water.

Cachets are providing a means of administering nauseous or disagreeable powder in a tasteless form.

Elixir are liquid, oral preparation of potent or nauseous medicaments, which are pleasantly flavoured and coloured with suitable agents.

Emulsions are suspensions of fats or oils in water with the inclusion of an suitable emulsifying agent (e.g. gum acacia, gum tragacanth) e.g. Castor oil emulsion, Cod liver oil emulsion for internal use. One such emulsion is also used externally e.g. benzyl benzoate emulsion.

Gels are the aqueous colloidal suspension of insoluble medicaments (e.g. aluminium hydroxide as antacid in Digene gel).

Linctus are viscous, liquid oral preparation containing high proportions of syrup (sugar) and glycerin (for viscosity and its sweet nature) which produce a demulcent affect on the mucous membrane of the throat.
Mixture are liquid oral preparation, where the medicaments are in solution or suspension form. Mixture are generally not formulated for a long life and prepared freshly.

Paediatric drops are liquid oral preparation of small dose giving by a calibrated dropper intended for paediatric use.

Solution are aqueous solution containing one or more drugs. They are divided into different categories:
- Solution in dosage form for oral use/external use e.g. strong iodine solution, hydrogen peroxide solution.
- Parenteral solution are sterile liquid or suspensions packaged in sterile containers, intended for parenteral administration.

There are other type of solutions that are used for peritoneal dialysis, anticoagulant solution, bladder irrigation and certain dermatological solution intended for application to broken surface.

Syrups are the liquid oral preparation made in concentrated sugar solution, mainly for paediatric use and for drugs which are unpleasant in taste.

Tinctures are the concentrated alcoholic preparation of vegetable drugs made by maceration process. (e.g. Tr. opium, Tr. lemon) used in different pharmaceutical preparation for oral use. Tr. Benzoin Co. is used externally.

Semisolid/Liquid Dosage Form (External use)

Applications are liquid or semi-liquid preparation applied to the skin, and are usually emulsion or suspension in nature (e.g. antiparasitics application).

Creams are semisolid preparation (usually emulsion) for external use. They are oily and non-greasy in nature.

Ear/eye/nasal drops are solution of drugs that are instilled into a ear, eye and nose with a dropper. The eye drops are sterile solutions.

Enema are solution, suspension or emulsion (oil/water type) of medicament intended for rectal administration.

Gargles are aqueous solution used to prevent and for treatment of throat infections.

Irrigators are medicated solution used to treat urinary bladder, vagina and less often the nose infections. They are administered with a help of catheter (in bladder), vulcanite (for vagina) which are made up of thin, soft rubber or plastic tube. The nose irrigator is made up of glass.

Jellies are transparent or translucent, non-greasy medicated semi-solid preparation used externally, sometime containing local anaesthetic agent also e.g. Lignocaine jelly.

Liniments are liquid, semi-liquid and sometimes semi-solid preparation used externally on the skin. Liniments are counter-irritant and stimulating type and are massaged or rubbed into the skin, and must not be applied to the broken skin e.g. liniment turpentine.

Lotions are liquid preparation applied to skin without friction. Lotions are used for soothing, astringent and antipruritic affects e.g. calamine lotion.

Mouth washes are liquid preparation similar to gargles but are use for oral hygiene.

Ointments are semi-solid greasy preparation for local application to the skin, rectum and mucous membrane also. The ointment base is usually anhydrous and contain the medicaments in solution or suspension. Ointments are used for its soothing, astringent, antiseptic and other selected actions e.g. chloromycetin eye ointment.

Paints are liquid preparation containing volatile solvent which quickly evaporate to leave a dry and resinous film of medicaments on the skin.

Throat paints are more viscous in nature (due to the high proportion of glycerine) which being sticky and adhere to the affected site and prolongs the action of the drug.

Pastes are semi-solid preparation for external application that differ from similar products (i.e.
ointment) in containing a high proportion of finely powdered medicaments. They afford greater protection and are more absorptive. The base may be anhydrous or water soluble e.g. zinc oxide paste.

**Poultices** are paste like preparation for external application to reduce inflammation due to its heat retaining capacity. After heating, the preparation is spread thickly on a dressing gauze and applied as hot as patient can bear it, to the affected area.

**Inhalation Form**

**Aerosols** are suspension of fine, solid or liquid particles in a medium like air or oxygen and administered with the help of nebulizers. They are used to apply drugs to the respiratory tract in asthmatic patients e.g. Asthalin (salbutamol) inhaler, Fintal (sodium cromoglycate) inhaler.

**Sprays** are preparation of drugs in oil or water, usually administered by atomizer or nebulizer. They are applied to the mucosae of nose or throat e.g. Tyrothricin spray.

**Vitrellae** are thin walled glass capsules containing volatile substance (drops) (e.g. amyl or octyl nitrite) and protected by absorbent cotton wool and an outer silk bag. This capsule is crushed and the vapours are inhaled in the treatment of angina.