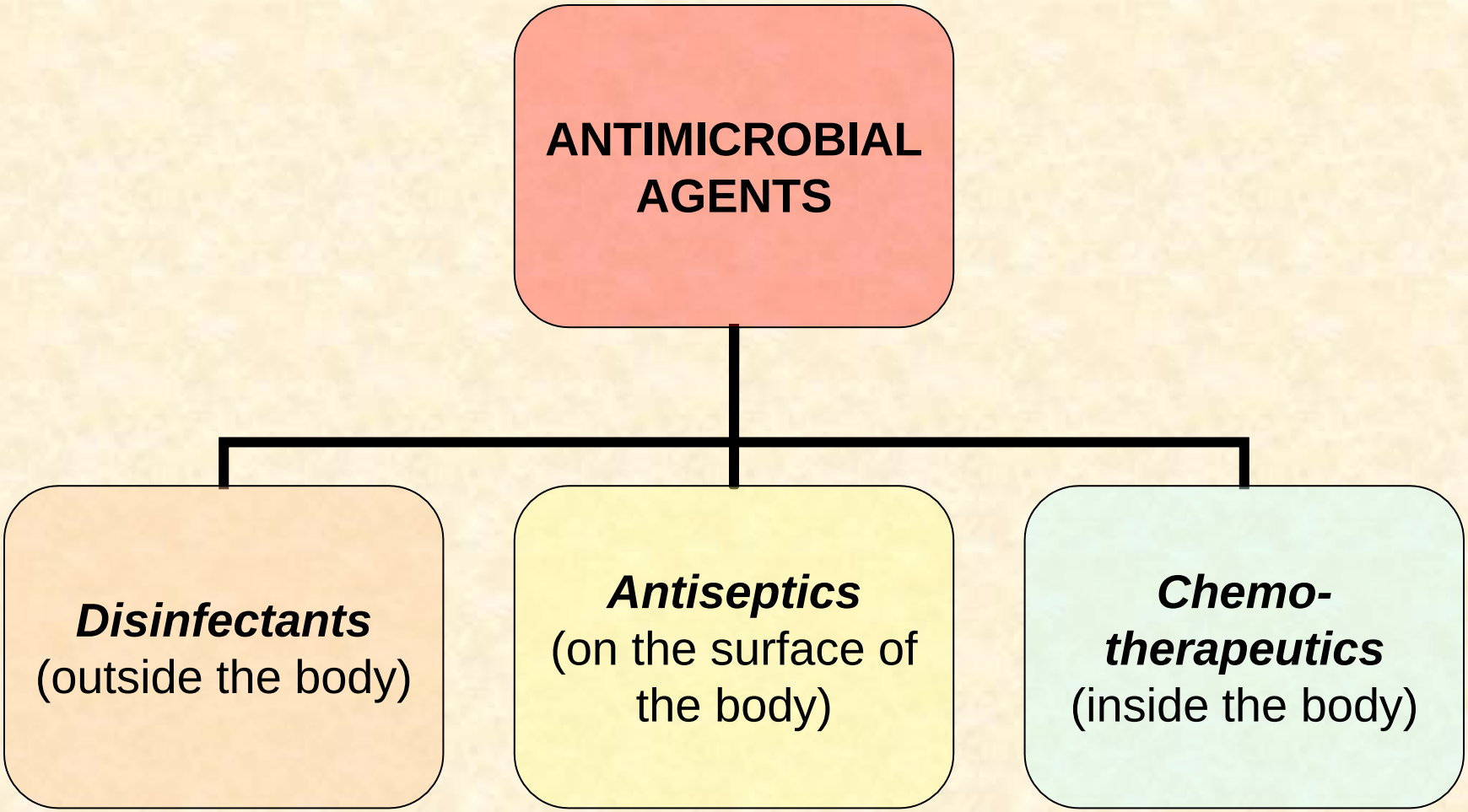
POLTAVA STATE MEDICAL UNIVERSITY

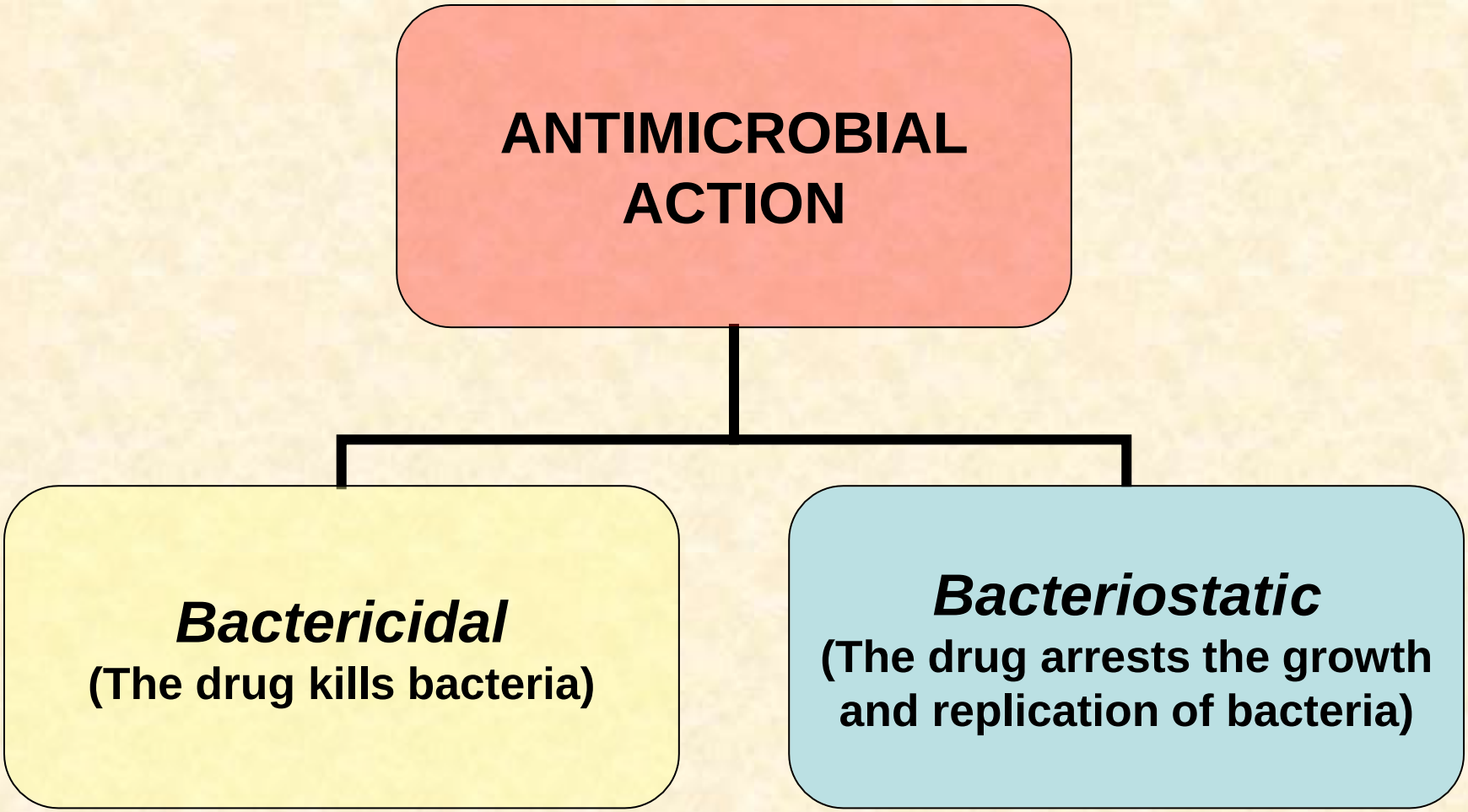
Lecture

ANTIMICROBIAL DRUGS: ANTISEPTICS AND DISINFECTANTS. SULFONAMIDES

ANTIMICROBIAL AGENTS



TYPES OF ANTIMICROBIAL ACTION



ANTISEPTICS AND DISINFECTANTS

ANTISEPTICS AND DISINFECTANTS:
DEMANDS

Good antiseptic and disinfectant should meet such demands as:

- Bactericidal action
- Chemical stability
- Rapid action
- Lack of absorption
- Low toxicity
- Efficacy in the presence of different organic substrates
- Absence of allergic properties
- Absence of irritability.

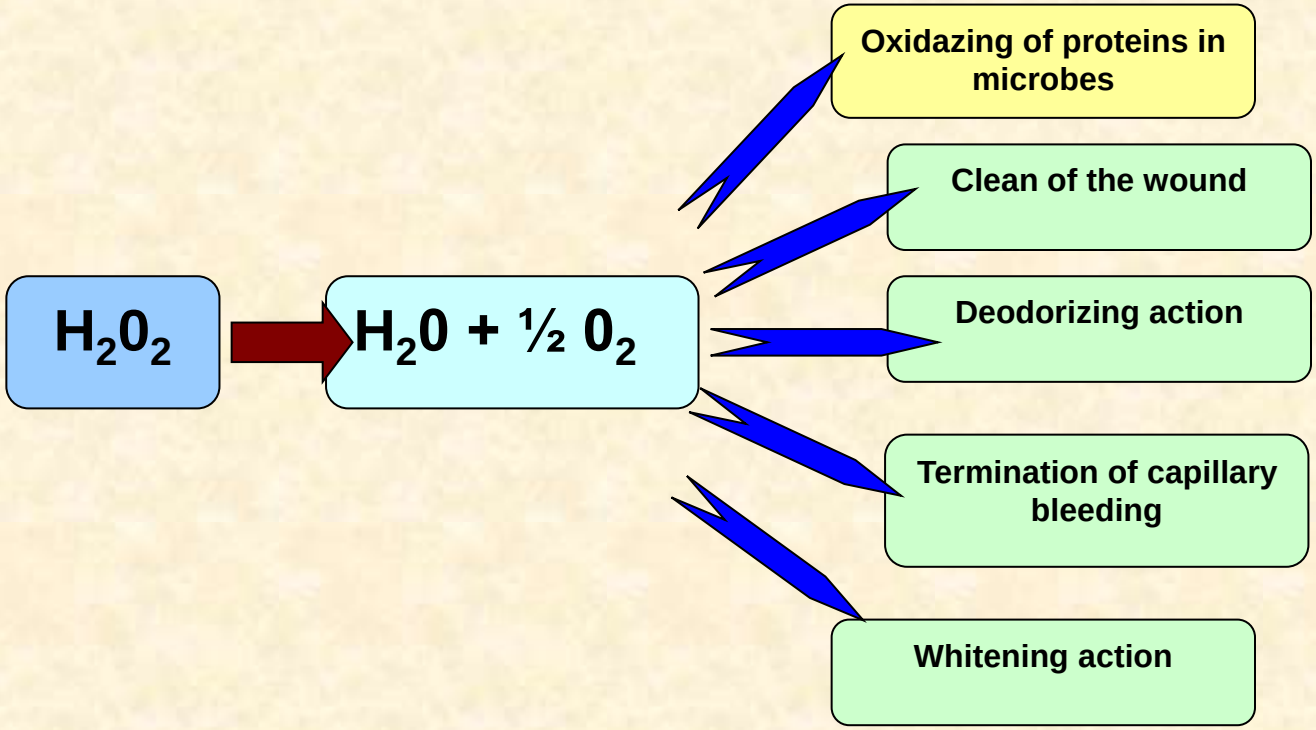
ANTISEPTICS AND DISINFECTANTS:
MAIN MECHANISMS OF ACTION

- Denaturation of bacterial proteins including enzymes
- Oxidation of bacterial protoplasma
- Changing of bacterial membrane properties and increase in its permeability

CLASSIFICATION

A. Inorganic substances	B. Organic substances
1. Halogens	***1. Aldehydes***
– Iodine (5% alcohol solution)	– Formaldehyde (Formalinum)
– Solution of Lugol	***2. Alcohols***
– Iodinol	– Ethyl alcohol (Spiritus aethylicus)
– Chloramine B	***3. Phenol derivatives***
– Chlorhexidine (Hibitane)	– Phenol (Phenolum purum, Carbolic acid)
2. Oxidizing agents	– Resorcinol
– Hydrogen peroxide	***4. Dyes***
– Potassium permanganate	– Methylene blue (Methylenum coeruleum)
3. Metallic salts	– Brilliant green (Viride nitens)
– Mercury dichloridum	– Etacridine lactate
– Yellow mercury oxide	***5. Detergents***
– Silver nitrate	– Aethonium
– Copper sulfate	– Decamethoxin
– Zinc sulfate	***6. Tar, resins, products of petroleum***
– Zinc oxide	– Birch tar (Pix liquida Betulae)
4. Acids and alkalis	– Ichthyol
– Salicylic acid	***7. Nitrofuran derivatives***
– Boric acid	– Nitrofurasone (Furacilinum)
– Solution of ammonia	***8. Antiseptics from medicinal plants***
	– Chlorophylliptum

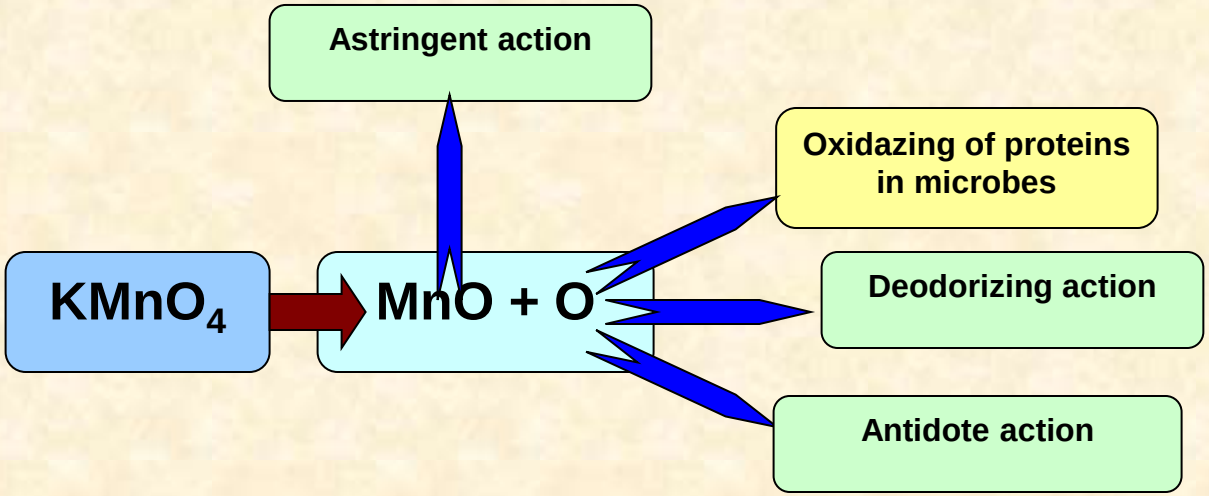
OXIDIZING AGENTS:
HYDROGEN PEROXIDE



Indications:

- processing of wounds
- processing of impaired skin
- gargling and mouthwash
- capillary bleeding
- whitening of teeth
- depigmentation of skin.

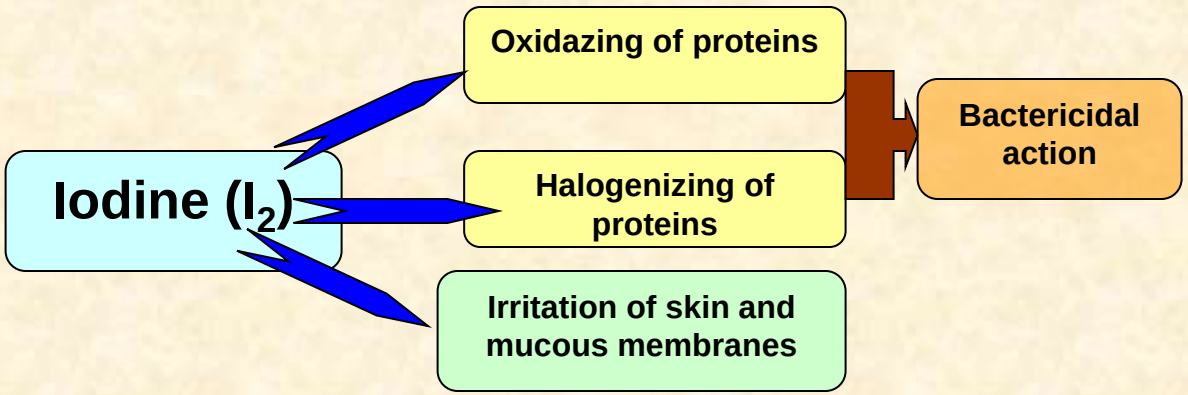
OXIDIZING AGENTS:
POTASSIUM PERMANGANATE



Indications:

- ***irrigation of purulent wounds***
- ***gargling and mouthwash in diseases of throat and oral cavity)***
- ***syringing in gynecology and urology***
- ***processing of burns***
- ***lavage of stomach in acute poisoning with morphine, alcohol, alkaloids***

HALOGENS:
IODINE ALCOHOL SOLUTION



Indications:

- processing of small cuts of the skin
- processing of surgery skin area and surgeon's hands
- dermatomycoses
- diseases of muscles and joints ("iodine network" on the skin).

HALOGENS:CHLORHEXIDINE

Chlorhexidine:

HALOGEN+DETERGENT=THE MOST POTENT ANTISEPTIC

- Antimicrobial and antifungal activity
- Stimulation of regeneration
- Is used for treatment of wounds, for gargling, for individual prophylaxis of sexually transmitted infections, for processing of surgeon's hands, surgery skin area, for quick sterilization of instruments
- May cause dry skin, grey discoloration of teeth if it is applied in the oral cavity

ACIDS AND ALKALIS

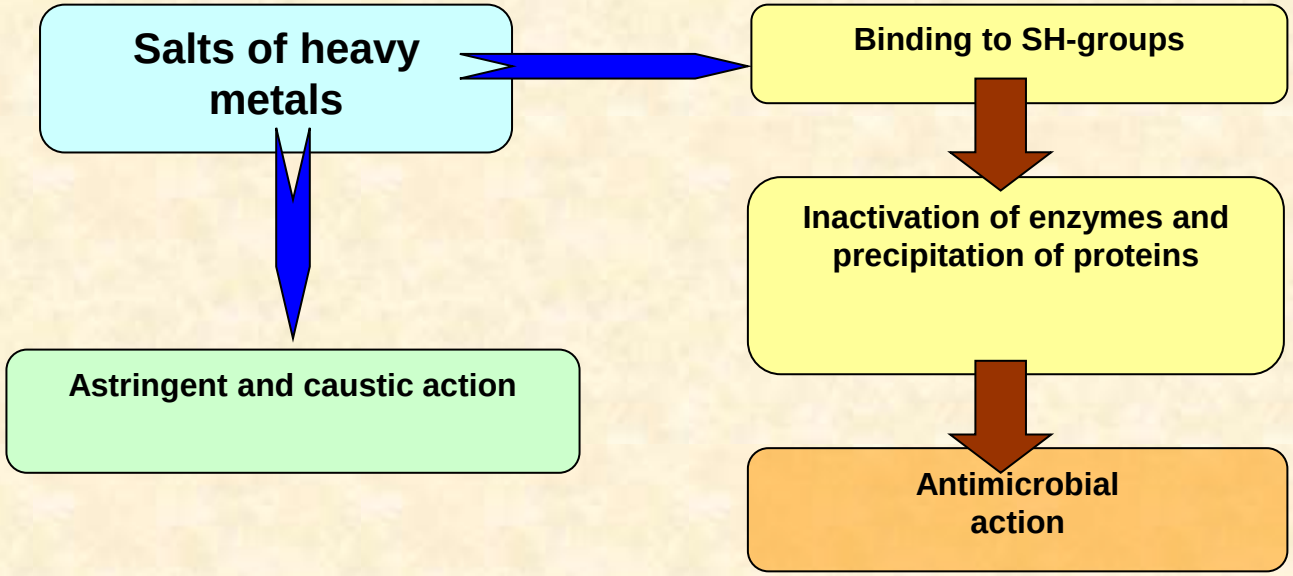
Mechanism of action:

Changes in pH leading to inactivation of enzymes and denaturation of microbial proteins.

Peculiarities of preparations:

- **Salicylic acid** has antimicrobial action, anti-inflammation, keratolytic action in bigger doses and keratoplastic action in lower doses; is used in dermatology.
- ***Boric acid*** has antimicrobial action; is used to treat purulent wounds, burns, skin diseases, external otitis, stomatitis, oral candidiasis in children, bacterial conjunctivitis.
- ***Solution of ammonia*** (10%) has antimicrobial, weak detergent, irritative, and reflexive actions; is used for processing of surgeon's hands but main indication is reflexive stimulation of respiration in syncope.

METALLIC SALTS:
MECHANISM OF ACTION



METALLIC SALTS:
PECULIARITIES OF PREPARATIONS

- ***Mercury dichloride*** has bactericidal effect which is decreased at the presence of proteins; is very toxic; is used for disinfection of clothes, non-metallic instruments.
- ***Yellow mercury oxide*** is not soluble, is used in the form of ointments for treatment of pyoderma, blepharitis, seborrhea, pediculosis.
- ***Silver nitrate*** rapidly kills microbes but action persisting for long period because of slow release of silver ions from silver proteinates; is used to cauterize erosions, ulcers, surplus granulations. Organic silver preparations (***Protargol, Collargol***) are indicated to treatment of conjunctivitis, diseases of throat, urological and gynecological diseases.
- ***Copper and zinc sulfates*** are applied for treatment of wounds, burns, diseases of oral cavity, eye infections, for the washing of urethra and urinary bladder. Copper sulfate is used in chemical burns caused by white phosphor.
- ***Zinc oxide*** is insoluble substance; has antimicrobial, astringent, and absorbting properties; is used as an ingredient of aspersions, ointments, and pastes to treat wounds, burns, skin diseases.

ALIPHATIC AGENTS:
ALCOHOL (SPIRITUS AETHYLICUS)

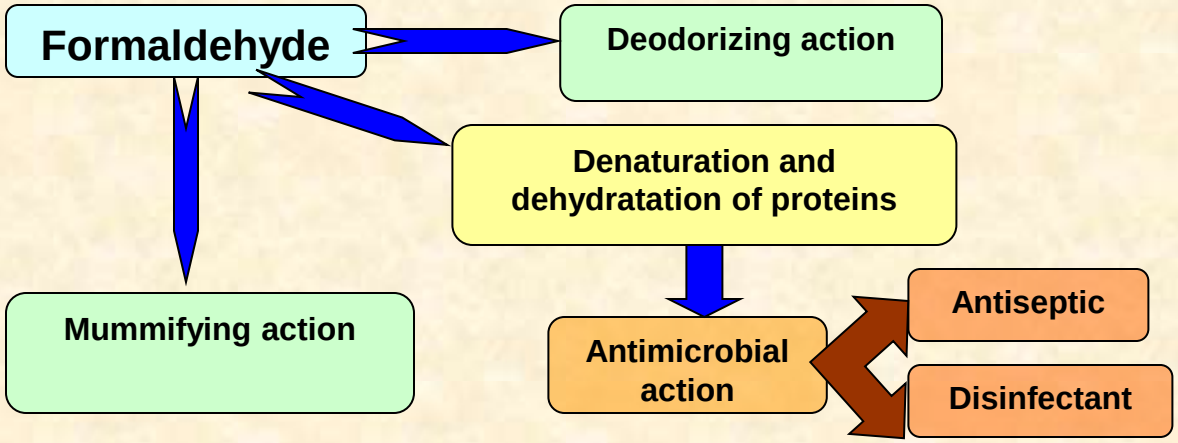
Mechanism of action and effects:

- Inhibition of oxido-reductases, dehydratation and precipitation of proteins
- Bactericidal action (antiseptic effect and disinfection)
- Irritating and tannic action

Indications:

- processing of surgeon's hands and surgical area (70%)
- processing of instruments (95%)
- compresses (40%).

ALIPHATIC AGENTS:
FORMALDEHYDE



Indications:

- feet sweating
- syringing in gynecology
- disinfection
- conservation of vaccines and serums
- conservation of anatomic preparations

AROMATIC COMPOUNDS: PHENOL (CARBOLIC ACID)

Mechanism of action and effects:

- It blocks dehydrogenases, denaturates proteins and damages membranes of bacteria
- One molecule of phenol can interact with few protein molecules by turn
- Phenol has bacteriostatic action in a low concentration and bactericidal action in a bigger concentration
- Action of aqueous solutions of phenol is stronger than effect of oil solutions
- It is reference preparation for comparison of other antiseptics

Indications:

- disinfection
- conservation of serums and drugs
- external otitis
- some forms of rhinitis (ozena)
- infections of oral mucosa and throat.

DYES

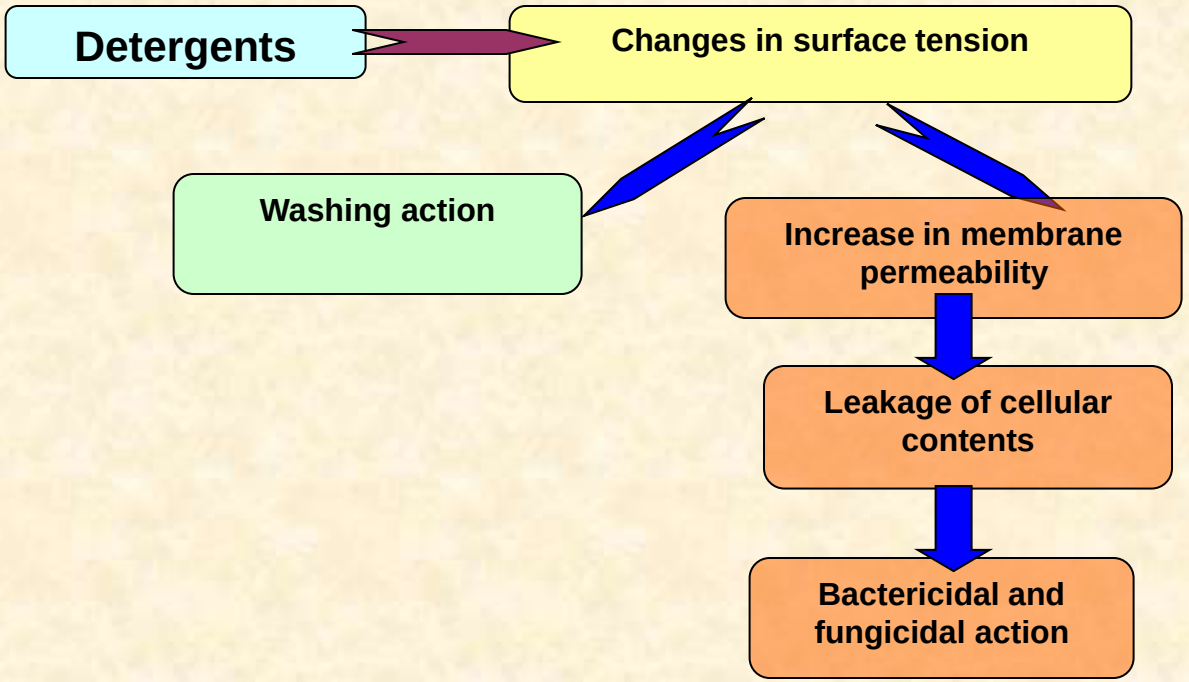
Mechanism of action and effects:

- Dyes inhibit bacterial enzyme systems
- Cations of dyes replace anions in natural compounds with formation of insoluble complexes.
- On antimicrobial action, dyes are less active than other antiseptics
- They act mainly on Gram (+) cocci.

Peculiarities of preparations

- **Metylene blue** is used for processing of burns, pyoderma, diseases of mucous membrane of oral cavity, for washing of urethra and urinary bladder, is an antidote in poisoning with cyanids, nitrites, and aniline derivatives
- ***Brilliant green*** acts mainly on staphylococci; is used for pyoderma, skin pustules, small cuts, blepharitis
- ***Etacridine lactate*** acts mainly on streptococci; is non-toxic, does not irritate tissues; is used for processing and treatment of wounds, washing of cavities, for conjunctivitis and for gargling.

DETERGENTS:
MECHANISM OF ACTION



DETERGENTS:

PECULIARITIES OF REPARATIONS

- ***Aethonium*** is a quaternary ammonium compound, cationic detergent; has antiseptic action, stimulates regeneration, causes local anesthesia and decreases intoxication; is used for the treatment of wounds, trophic ulcers, radiation injures, eye diseases, otitis, tonsillitis, burns, dermatitis.
- ***Decamethoxinum*** is a quaternary ammonium compound, cationic detergent; is similar to Aethonium; may be used for processing of surgeon's hands, surgical area, disinfection of surgical instruments and nursing items, for irrigations of bronchi, washing of cavities.

NITROFURAN DERIVATIVES:
NITROFURASONE (FURACILINUM)

Mechanism of action and effects:

- Inhibition of carbohydrates metabolism and tissue respiration in bacteria
- Bactericidal and bacteriostatic action.

Indications:

- washing out and treatment of purulent wounds, ulcers, burns
- irrigation of cavities
- gargling
- otitis
- skin pustules
- conjunctivitis

EUCALYPT AND HYPERICUM AS SOURCES OF ANTISEPTICS

ANTISEPTICS FROM MEDICINAL PLANTS:
PECULIARITIES OF PREPARATIONS

- ***Chlorophylliptum*** is a mixture of chlorophylls from eucalypt; acts mainly on cocci (staphylococci); is applied for the treatment of wounds, burns, trophic ulcers, erosions of uterus cervix, irrigations of cavities; may be used IV in sepsis or pneumonia caused by staphylococcus; causes allergy.
- ***Novoimaninum*** is an antiseptic from the herb of Hypericum, acts on Gram (+) cocci, is used topically for the treatment of wounds, burns, abscesses, etc.

ANTISEPTICS IN DENTISTRY

Antiseptics are used to treat:

- **diseases of teeth (caries, pulpitis, periodontitis)**
- **infections of mucous membrane of the oral cavity, gums, tongue, and lips (stomatitis, gingivitis, glossitis, heilitis)**
- **infections of parodontum (parodontitis)**
- **infections of bone tissue (osteomyelitis, periostitis)**
- **surgical diseases of maxillofacial area (abscesses, phlegmon, wound infection, traumas).**

USE OF ANTISEPTICS IN DENTISTRY

Hydrogen peroxide - washing of caries cavity and dental root channels; processing of dental root channels; whitening of teeth; termination of capillary bleeding; gargling.

Potassium permanganate - gargling.

Iodine alcohol solution – determination of hygiene indexes

Iodinol – processing of caries cavity and dental root channel (except frontal teeth)

Solution of Lugol– diagnostics of chronic inflammation of gums; paint of oral mucosa in stomatitis and oral candidiasis

Chloramine B – processing of caries cavity and dental root channels; instillations into pathological dental pockets; disinfection

Chlorhexidine– processing and washing of caries cavity and dental root channels; Instillations into pathological dental pockets; prevention of teeth deposit formation; gargling in stomatitis, gingivitis, parodontitis

Boric acid – gargling in stomatitis; processing of mucous membrane in oral candidiasis (in babies)

Salicylic acid – hyperkeratosis; heilitis

Yellow mercury oxide– heilitis

Silver nitrate – ionophoresis; silvering of dental root channels; impregnation of dental bone and dental root channel

Copper sulfate – electrophoresis of gums; instillations into pathological dental pockets; gargling in stomatitis, gingivitis, and parodontitis

USE OF ANTISEPTICS IN DENTISTRY

Ethyl alcohol (70%) – processing of dental root channels

Formaldehyde– dental pulp mummifying; diagnostics and treatment of periodontitis

Phenol – processing of dental root channels; processing of the wound afte ther tooth extraction; treatment of relapsive aphthous stomatitis; administration into caries cavity for abolishing of toothache; infections of the oral mucosa (spray)

Resorcinol – cauterization of granulations in dental root channel; processing of pathological papilla of the tongue

Brilliant green – paint of rash elements on the mucous membrane; paint of pustules on the skin of the face

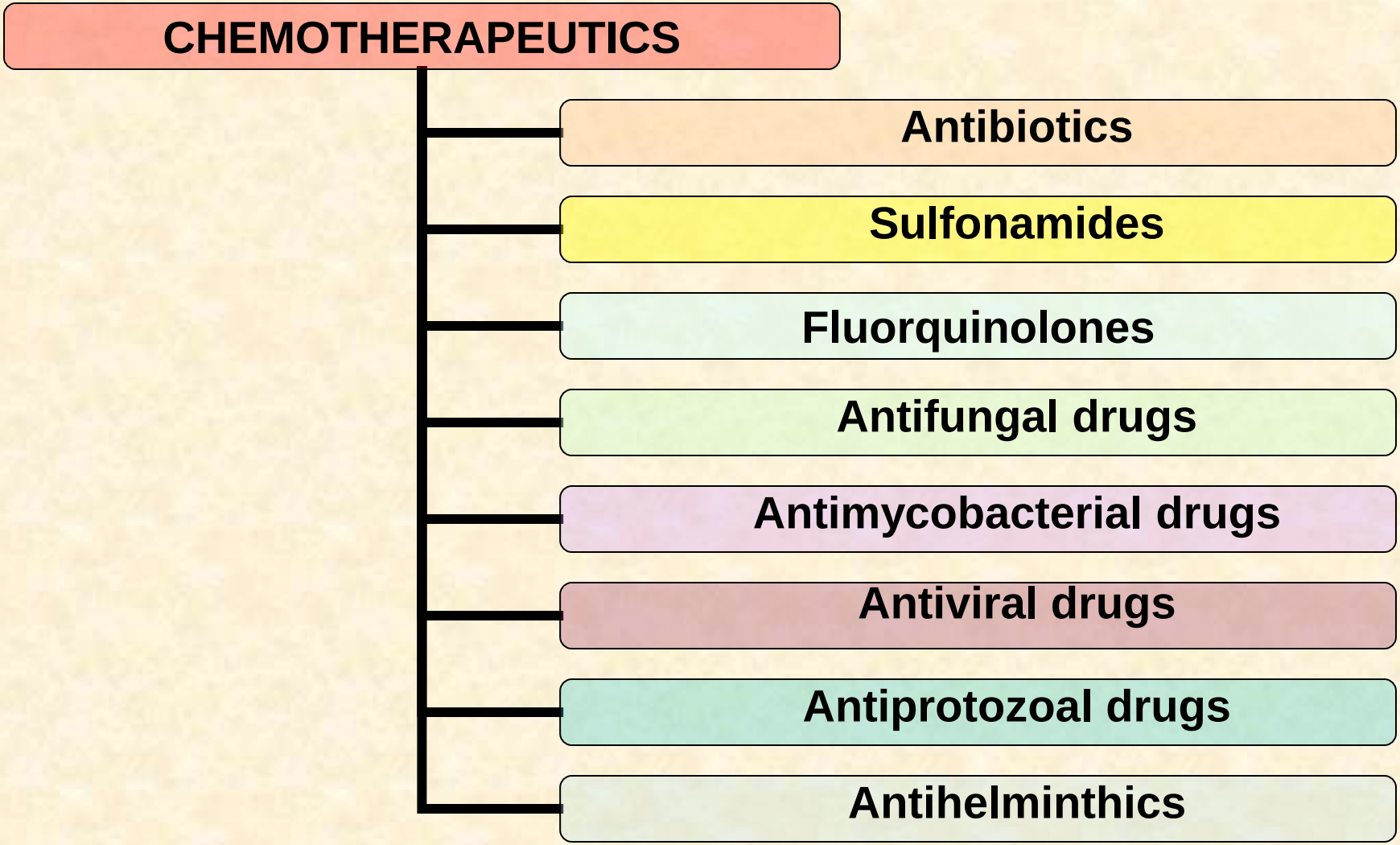
Decamethoxinum – processing of dental root channels; gargling in stomatitis and gingivitis

Nitrofurasone – processing of caries cavity and dental root channels; gargling in stomatitis and gingivitis; instillations into pathological dental pockets

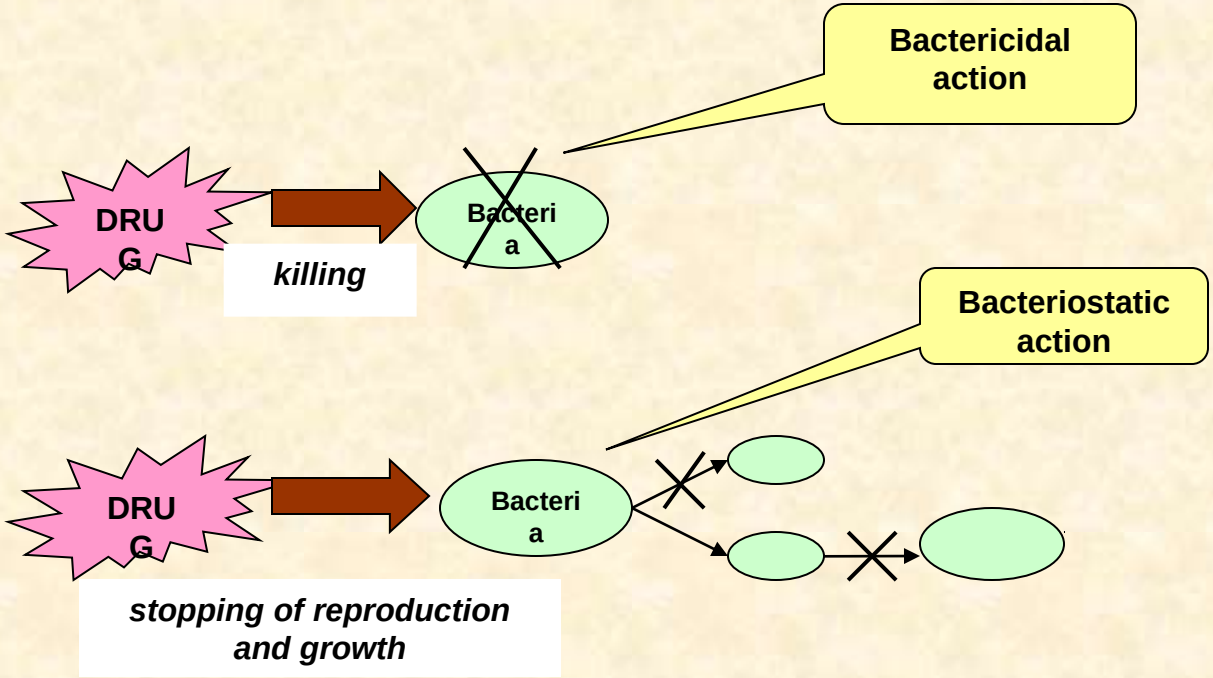
Chlorophylliptum – processing of erosions and ulcers in oral cavity; gargling; biological method of treatment of pulpitis

CHEMOTHERAPEUTICS

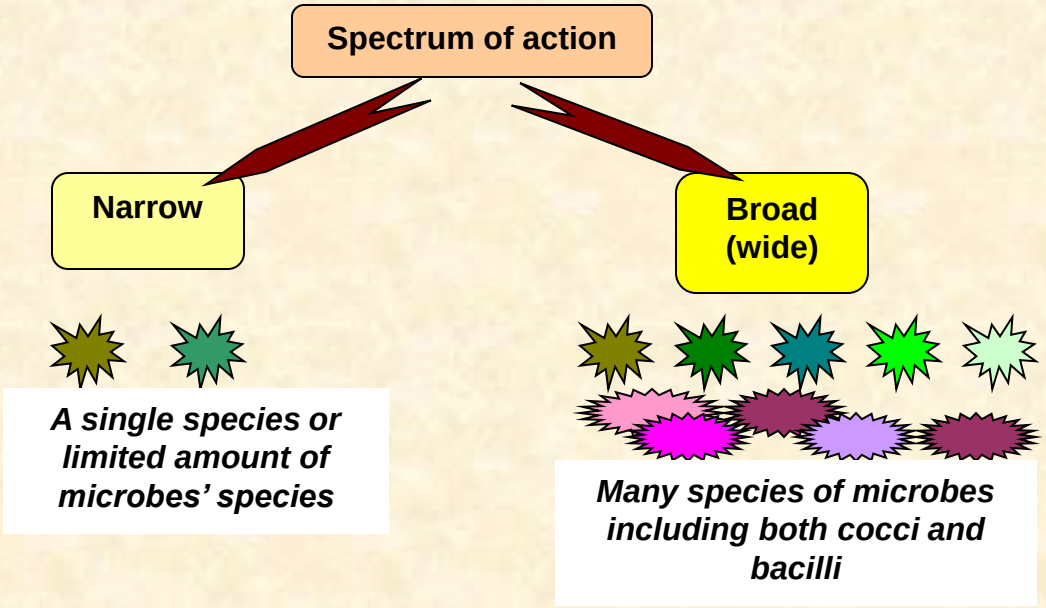
MAIN CLASSES OF CHEMOTHERAPEUTICS



TYPES OF ACTION



SPECTRUM OF ACTION

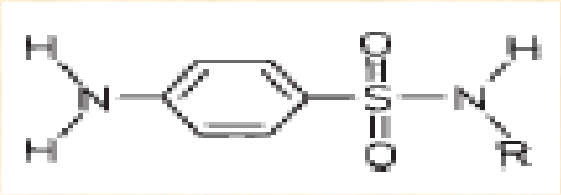


GENERAL PRINCIPLES OF ANTI-INFECTIVE THERAPY

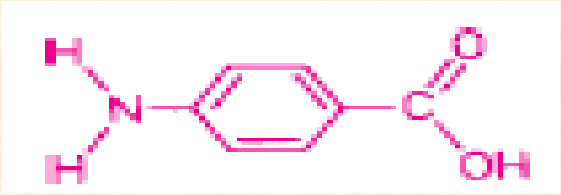
- Selection of chemotherapeutic agent on the spectrum of action
- Selection of chemotherapeutic agent on the laboratory identification of the infecting microorganism
- Selection of the optimal route of administration and dose
- The maintenance of constant chemotherapeutic concentration
- Discontinuation of chemotherapy in 2-3 days after the normalization of body temperature
- Rational combination of drugs
- Taking into account patient's sensitivity to the drug (allergic test before the start of treatment)
- Taking into account the site of infection, the immune competence, the age, and physiological status
- Clinical and laboratory monitoring of therapeutic response to drug therapy

SULFONAMIDES

Sulfonamides (A) are synthetic antimicrobials of wide spectrum of action, sructural analogs of para-aminobenzoic acid (PABA) (B)



A



B

SULFONAMIDES:
CLASSIFICATION

A. Highly absorbed sulfonamides

1. Short-acting

– Sulfamethazine (Sulfadimezinum)
– Aethazolum
– Norsulfazolum

2. Intermediate-acting

– Sulfamethoxazole

3. Long-acting

– Sulfamethoxypyridazine (Sulfapyridazinum)
– Sulfadimethoxine

4. Ultralong-acting

– Slfamethoxypyrazine (Sulfalenum)

B. Poorly absorbed sulfonamides

– Phthalylsulfathiazole (Phthalazolum)

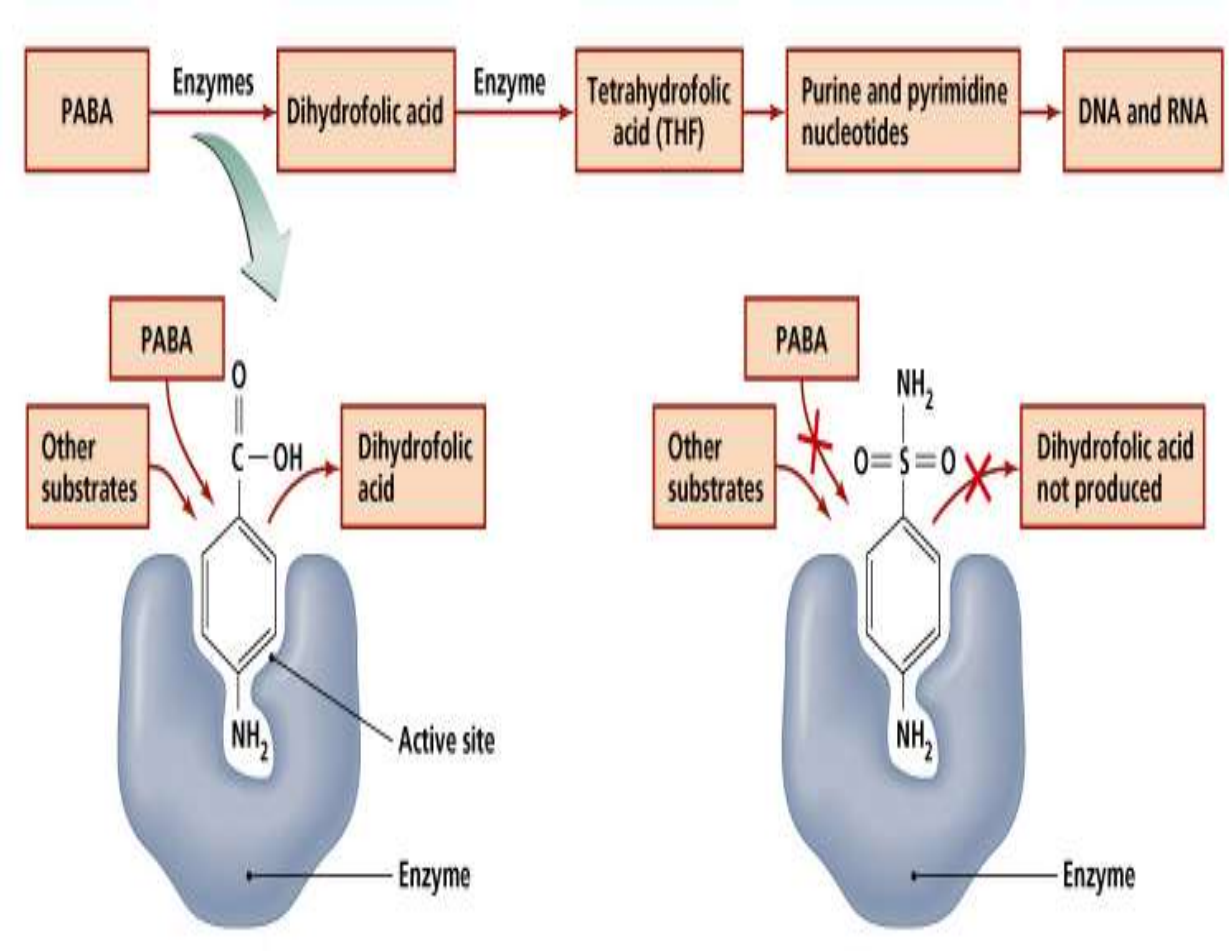
C. Sulfonamides for local use

– Sulfacetamide sodium (Sulfacylum natrium, Albucid)
– Sulfonamide (Streptocidum)

D. Combinations of sulfonamides and trimethoprim

– Co-trimoxazole (Bactrim).

SULFONAMIDES:
MECHANISM OF ACTION



SULFONAMIDES:
PECULIARITIES OF PREPARATIONS

- ***Sulfacetamide sodium*** is a well-soluble substance, is used as eye-drops for conjunctivitis, trauma of the eye, prophylaxis of eyes gonorrhea in newborns.
- ***Phtalylsulfathiazole*** is inactive in vitro but active in the intestine because of norsulfazole's liberation; is used for gastrointestinal infections.
- ***Aethazolum*** is rapidly absorbed in the gut and rapidly excreted; is used in urinary tract infections and nocardiasis.
- ***Sulfadimethoxine*** is a long-acting sulfonamide, is rapidly absorbed but slowly excreted, has a half-life of 24-48 hrs, is concentrated in bile thus is suitable to treat cholecystitis.
- ***Sulfalene*** is ultralong-acting sulfonamide, has a half-life of more than 48 hrs due to strong bonds with serum albumins and reabsorption in the kidney; is suitable to treat long-durative infections.

COMBINED SULFONAMIDES

Co-Trimoxazalole = sulfamethoxazole + trimethoprim.

- Sulfamethoxazole inhibits dehydropteroide synthase (stage I of synthesis of active form of folic acid)
- Trimetoprim inhibits dehydrofolate reductase (stage II of synthesis of active form of folic acid)
- A result is bactericidal action
- Antimicrobial spectrum of trimethoprim is similar to that of sulfonamide however the combination is in 20-50 times more potent than sulfonamide
- Pharmacokinetics of trimethoprim is similar to the same of sulfamethoxazole
- Co-trimoxazole is used to treat *Pneumocystis Carrini* pneumonia, respiratory infections, gastrointestinal infections (shigellosis, non-typhoid salmonella infections, carrierity of *Salmonella typhi*), genital infections (gonorrhea), prostate and urinary tract infections

SULFONAMIDES:
SIDE EFFECTS

- Crystalluria
- Allergy
- Hemopoietic disturbances
- Dermatitis and phototoxicity
- Stevens-Johnson syndrome
- Hepatitis
- Idiosyncrasy (hemolytic anemia in patients with deficiency of glucose-6-phosphate dehydrogenase).

SULFONAMIDES:
USE IN DENTISTRY

Aethazolum – prevention of infection after the tooth extraction (non-dosed powder); alveolitis

Norsulfazolum – acute deep caries and pulpitis; filling of dental root channels (stomatological paste)

Co-trimoxazole – biological method of the treatment of pulpitis; ulcers and erosions of the oral mucous membrane in stomatitis (suspension)