Chemical disinfectants, antiseptics and preservatives

Chapter 19

مهم جدا نعرف levelاتبع disinfectantوفي اشي اسمه level of action for disinfictant

Definitions

- Disinfection: the process of removing MOs, including pathogens, from the surface of inanimate objects
- Chemical disinfectants are capable of different levels of action:

اذا كان disin عنده القدره يقتل
most vegetative
bacteria
viruses
Fungiويخلي M .tub
Sporesما يقدر يقتلهم يعني

Table 19.1 Levels of disinfection attainable when products are used according to manufacturer's instructions

مقسمين بناءا على kill

	Disinfection level Low	Disinfection level Intermediate	High
Microorganisms killed	Most vegetative bacteria Some viruses Some fungi	Vegetative bacteria including *M. tuberculosis* Most viruses including hepatitis B virus (HBV), Most fungi	All microorganisms unless extreme challenge or resistance exhibited
Microorganisms surviving	*M. tuberculosis* Bacterial spores prions	Bacterial spores Prions	Extreme challenge of resistant bacterial spores Prions

Definitions

non toxic لازم تكون
Not irritant

- Antisepsis: destruction or inhibition of MOs on living tissues having the effect of limiting or preventing the harmful results of infection
- Should be non toxic or irritating to mucous membranes and skin
- Uses:

- Reduce microbial population on the skin before surgery
- On hands to help prevent spread of infection

Definitions

يعني لازم اطلع productيكونquality تبعبيه كثير منيح ولكن نتيجه الاستخدام ممكن يدخل M.Oوهون preservative يجي وظيفه

- Preservatives are included in pharmaceutical and many type of formulations to prevent microbial spoilage of the product:

1. Non sterile products: to limit proliferation of MO that may be introduced unavoidably into non-sterile products such as oral and topical medications during their manufacture and use
2. Sterile products (multi-use preparations): preservatives should kill any microbial contaminants introduced inadvertently during use

Ophthalmic /drop

3. Should be non toxic in relation to the intended route of administration

بوخذ بعين الاعتبار role of administrantio

Factors affecting choice of antimicrobial agents

من خلالها بحدد اذا هو antiseptic or preservative

1. Properties of chemical agent:

- Tissue toxicity: determine whether the agent can be used as an antiseptic or preservative

2. The type of MO and the levels of contamination:

الاشياء الي اوخذها بعين الاعتبار لحتى احدد biocided agent المناسب

Viruses, fungi, spores…etc

High bioburden→ long exposure time and/or higher conc.

3. Intended application:

- The ingredients in preparations may antagonize preservative activity

في اشياء بقدر استخدمها على skin وفي اشياء لا

- Risk to patient (break skin or introduced into sterile area of the body)
- Disinfectant should not corrode instrument, affect clarity of lenses

ما بتخرب الادوات

Factors affecting choice of antimicrobial agents

4. Environmental factors:

داخل المركب ممكن يكون في مواد تعادل disinfected

- Bloody fluids, pus, ..

اذا في على ايدي دم ما يزبط استخدم كحول لتعقيم

- Objects to be disinfected should be thoroughly cleaned (since dried organic deposits may inhibit penetration of the biocidal agent)
- Presence of ions (hard water)

فيها Mg ..... kممكن يخرب شغل disinfectant لذلك استخدم distilled water

Types of compound Acids and esters

هدول الدكتوره حكت شرح للجداول الطويله
تذكروهم واحنا ندرسهم لحالنا

1. Benzoic acid:

- The non ionized acid is the active substance
- pKa of benzoic acid=4.2 (at this pH 50% of benzoic acid is ionized)
- It is advisable to limit use of acid to preservation of pharmaceuticals with a maximum of final pH of 5.0
- 0.05%-0.1% for oral preparations
- Benzoic acid + salicylic acid → used in the treatment of superficial fungal infections

2. Sorbic acid:

- pKa=4.8
- Gums, mucilages and syrups

Types of compound
Acids and esters

3. Esters of p-hydroxybenzoic acid (parabens):

- Alkyl esters of p-hydroxybenzoic acid

- Developed to overcome the marked pH dependence on activity of the acids
- pKa 8-8.5
- Exhibit good preservative activity even at pH levels of 7-8
- Active against a wide range of fungi but are less so against bacteria especially pseudomonas which may utilize them as carbon source
- Frequently used as preservatives of emulsions, creams and lotions where two phases exists

Types of compound
Acids and esters

3. Esters of p-hydroxybenzoic acid (parabens)- continued:

- Combinations: the more water-soluble ester protects the aqueous phase, whereas the propyl or butyl esters give protection to the oil phase
- Limitation: inactivation of parabens occurs with non-ionic surfactants (care must be taken in formulation with both materials)

Types of compound
Alcohols

1. Alcohols used for disinfection and antisepsis:

- Ethanol and isopropanol are used for disinfection and antisepsis
- Bactericidal but not sporicidal
- Cidal activity drops sharply below 50% concentration
- Alcohols have poor penetration of organic matter and thus their use restricted to clean conditions
- Widely used for skin preparation before injection or other surgical procedures
- Alcohol hand-rub

Types of compound
Alcohols

- The presence of water is essential for activity of ethanol→ 100% ethanol is relatively ineffective:
- 60-95% are bactericidal
- 70% is usually employed for the disinfection of skin, clean instruments or surfaces
- 90% ethanol is also active against fungi and most lipid-containing viruses including HIV
- Also ethanol a popular choice in pharmaceutical preparations and cosmetic products as a solvent and preservative

يعمل coagulateللبروتين
ف اذا حطيت كحول 100%saturatedلما تجي على البكتيريا)رح يعمل coagulateللبروتين اول ما يدخل لذلك رح يصير طبقه (من الكاوشوك هيك سمعتها) ويبطل يدخل الكحولويبطل membraneينفذ المواد وهيك رح تضل البكتيريا داخل membraneوتتكاثر

70% percent of alcohol is ideal to a stronger solution. Pure alcohol coagulates protein in contact. Suppose the pure alcohol is poured over a single celled organism. The alcohol will go through the cell wall of the organism in all direction, coagulating the protein just inside the cell wall. The ring of the coagulated protein would then stop the alcohol from penetrating farther from the cell, and no more coagulation would take place. At this time the cell would become inactive but not dead. Under the favorable conditions the cell would then begin to function. If 70 percent of alcohol is poured to a single celled organism, the diluted alcohol also coagulates the protein, but at a slower rate, so that it penetrates all the way through the cell before coagulation can block it. Then the entire cell is coagulated and the organism dies. Why is 70% ethanol used for wiping microbiological working areas? - ResearchGate. Available from: https://www.researchgate.net/post/Why_is_70_ethanol_used_for_wiping_microbiological_working_areas [accessed Feb 19, 2016].

Types of compound
Alcohols

- 2. alcohols as preservatives:
- Benzyl alcohol
- Chlorobutol: decompose at acid pH during autoclaving
- Phenoxyethanol
- Bronopol: when exposed to light at alkaline pH → solutions decompose turning yellow or brown (decompose to formaldehyde and nitrite ions). Nitrite ion may react with amines to form nitrosamines (carcinogenic)

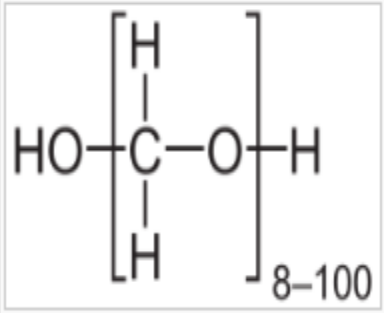
Types of compound: Aldehydes

1. Formaldehyde:

- HCHO
- Can be used in either the liquid or gaseous state for disinfection
- Gaseous state for disinfection of isolators, safety cabinet, and rooms
- Vapor is highly toxic and potentially carcinogenic if inhaled
- The agent is not supplied as a gas but either as a solid polymer (paraformaldehyde) or a liquid (formalin) which is 34-38% aqueous solution

Forms of formaldehyde [edit]

Formaldehyde is more complicated than many simple carbon compounds in that it adopts several different forms. As a gas, formaldehyde is colorless and has a characteristic pungent, irritating odor. Upon condensation, the gas converts to various other forms of formaldehyde (with different chemical formulas) that are of more practical value. One important derivative is the cyclic trimer metaformaldehyde or 1,3,5-trioxane with the formula $(CH_2O)_3$. There is also a linear polymer called paraformaldehyde. These compounds have similar chemical properties and are often used interchangeably.



Paraformaldehyde is a common form of formaldehyde for industrial applications.

When dissolved in water, formaldehyde also forms a hydrate, methanediol, with the formula $H_2C(OH)_2$. This compound also exists in equilibrium with various oligomers (short polymers), depending on the concentration and temperature. A saturated water solution, of about 40% formaldehyde by volume or 37% by mass, is called "100% formalin". A small amount of stabilizer, such as methanol, is usually added to suppress oxidation and polymerization. A typical commercial grade formalin may contain 10–12% methanol in addition to various metallic impurities. Aqueous formaldehyde is also called 'formalin'.

Occurrence [edit]

Processes in the upper atmosphere contribute up to 90% of the total formaldehyde in the environment. Formaldehyde is an intermediate in the oxidation (or combustion) of methane, as well as of other carbon compounds, e.g. in forest fires, automobile

Types of compound: Aldehydes

1. Formaldehyde (cont.):

- The gas is liberated by heating or mixing the solid or liquid with potassium permanganate and water
- Too irritant for routine application to skin

Types of compound: Aldehydes

- 2. formaldehyde-releasing agents:
- Have been developed to reduce the irritancy associated with formaldehyde while maintaining activity
- Noxythiolin (N-hydroxy N-methylthiourea):
- Dry powder
- On aqueous reconstitution slowly release formaldehyde a
- Polynoxylin
- Taurolidine

Types of compound: Biguanides

- 1. Chlorhexidine:
- Cationic
- Activity reduced by anionic compounds
- Widespread use as antiseptic

Types of compound: Halogens

- 1. Chlorine:
- Gaseous chlorine
- Liquid chlorine: made by compressing and cooling gaseous chlorine
- 2. Sodium hypochlorites (bleach):
- It is preferable to prepare use-dilutions (working solutions) of hypochlorite on daily basis
- Undiluted bleach stored at room temperature in a closed container has a shelf life of about 6 months
- Storage of stock or working solutions of bleach in open containers causes release of chlorine gas → weaken antimicrobial activity

Types of compound: Halogens

تعقيم بير المي

- 3. organic chlorine (chloramine) compounds:
- Such as chloramine-T, dichloramine-T and halazone→ may be used for disinfection of contaminated drinking-water

Types of compound: Halogens

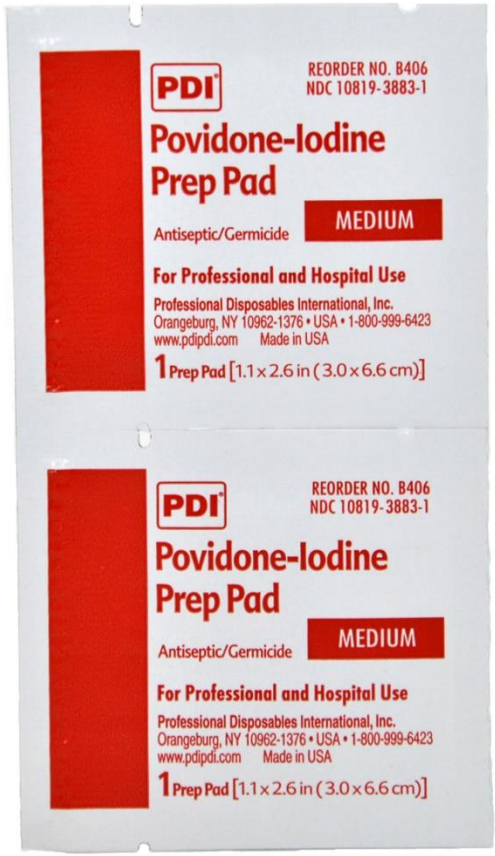
- 4. Iodine:
- Has a wide spectrum of antimicrobial activity: gram – ve, gram + ve, bacterial spores, mycobacteria, fungi and viruses
- Elemental iodine I_2 is the active agent
- 5. iodophors
- Iodo (iodine) and phor (carrier)
- An **Iodophor** is a preparation containing iodine complexed with a solubilizing agent, such as a surfactant or povidone (forming povidone-iodine). The result is a water-soluble material that releases free iodine when in solution
- Polyvinylpyrrolidone iodophors (PVP-I or povidine-iodine)

مش كثير استخدام I2 وبالغالب بستخدمه على شكل complex iodophorm

More water soluble


Povidone-Iodine Ointment 10%
Maximum Strength
First Aid Antiseptic
NET WT 1 OZ (28 g)


Jodine-
Povidone®
Spray
Povidono jodas
10% vandeninis tirpalas
10% Povidone Iodine
Solution in Aqua
Odos tirpalas
žaizdų priežiūrai 50 ml.
Vartoti išoriškai ant odos.
CE 50 ml
dine-Povidone
Spray
50 ml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Types of compound: Heavy metals

- Mercury and silver
- Largely replaced by less toxic compounds
- 1. mercurials:
- Thiomersal, PMN, PMA→ preservatives
- Use declines due to toxicity, hypersensitivity and local irritation

Types of compound: hydrogen peroxide and peracetic acid

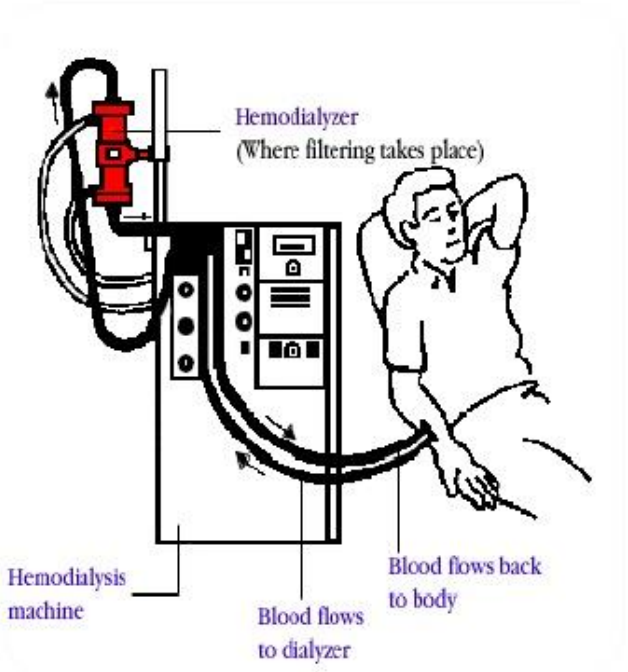
الهم تاثير synergistic

- High level disinfectants because of their production of highly reactive hydroxyl radical
- Hydrogen peroxide works by producing destructive hydroxyl free radicals that can attack membrane lipids, DNA, and other essential cell components
- Hydrogen peroxide is active against a wide range of microorganisms, including bacteria, yeasts, fungi, viruses, and spores
- Combination of hydrogen peroxide and peracetic acid is synergistic → cold sterilant for dialysis machine

ليس بحاجه للحراره

Per acetic acid and hydrogen peroxide useful in Hem dialyzers

- Findings demonstrated that this product inactivated all microorganisms with the exception of bacterial spores within 20 minutes. The combination of per acetic acid and hydrogen peroxide has been used for disinfecting hem



Cold Sterilants لغسيل الكلى

The Renal Systems Group carries two types of cold sterilants. Renalin® 100 is used for reprocessing dialyzers with the Renatron® II 100 Series machine. Actril® is used for surface disinfection. Both products are a mixture of peracetic acid, hydrogen peroxide and acetic acid. They leave no toxic residues and after reacting with organic material, they decompose into oxygen and acetic acid. These cold sterilants destroy viruses, bacteria, spores and fungi.

Renalin® 100 Cold Sterilant

Renalin® 100 Cold Sterilant
(For International Use Only)

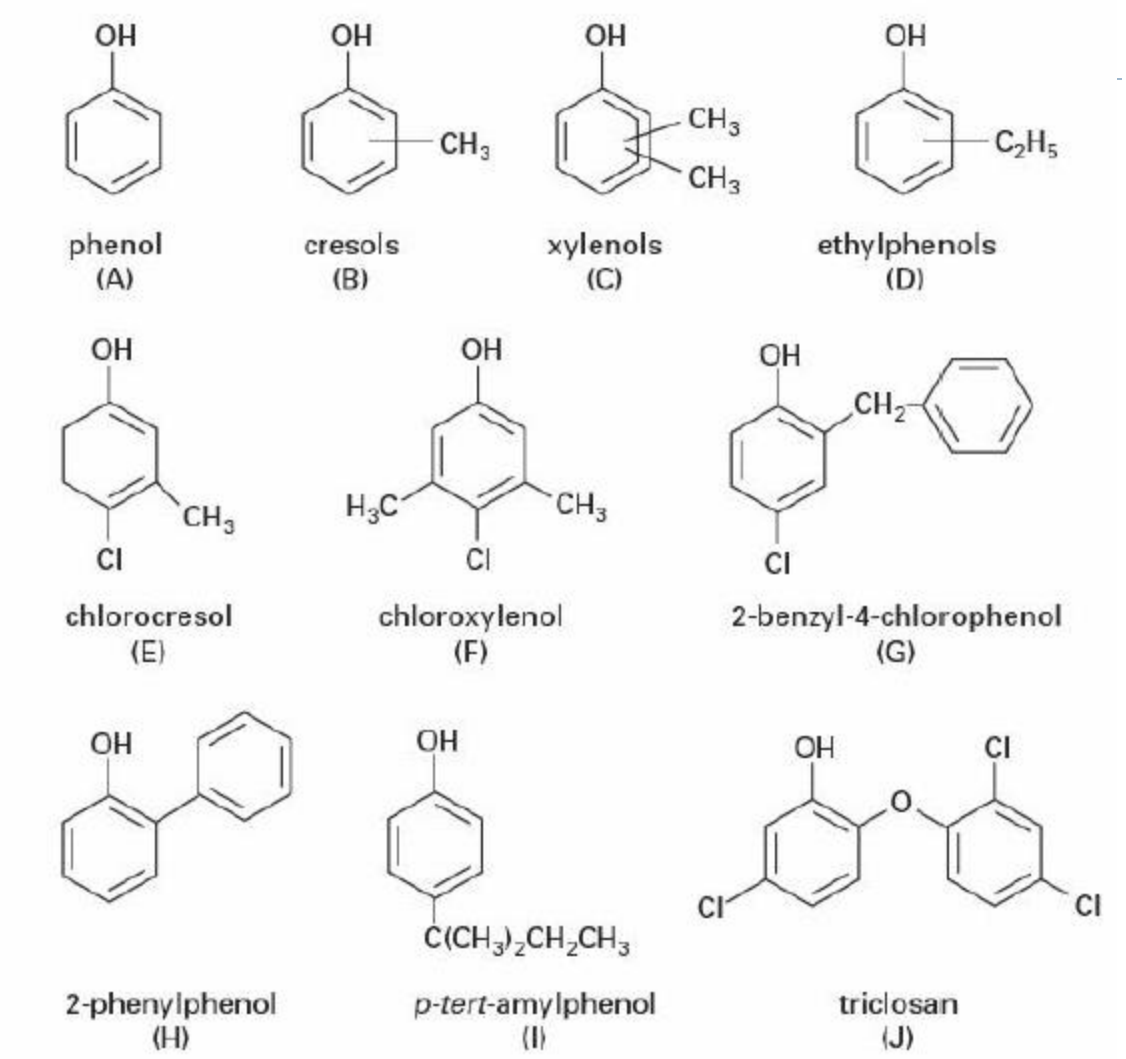
Actril® Cold Sterilant

4) Cleanser for contact lens

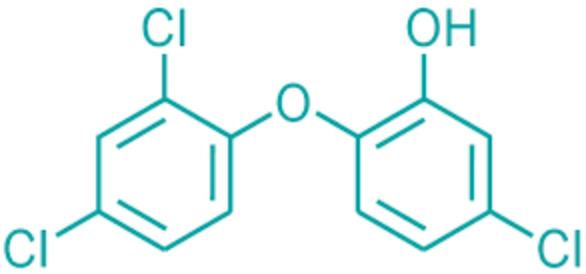
Hydrogen peroxide disinfectant capacity is put to use in the contact lens cleaning solution. It is known that proteins get build up on lenses and using this chemical compound breaks the proteins.

Types of compound: Phenols

- Phenols naturally obtained by distillation of coal or petroleum (phenols, cresol, xylenols)
- Synthetic phenols: chlorocresol (p-chloro-m-cresol) and chloroxylenol (p-chloro-m-xylenol)
- Chlorocresol→ antiseptic & preservative
- Chloroxylenol→ antiseptic& disinfectant
- Triclosan: two phenolic groups. Medicated soap,, lotions, and solutions



Structures of some common phenols possessing antimicrobial activity



Triclosan

Drug Facts

Active ingredient	Purpose
Triclosan 0.46%	Antibacterial

Use For handwashing to decrease bacteria on the skin.

Drug Facts

Active ingredients	Purpose
Sodium fluoride 0.24% (0.14% w/v fluoride ion)	Anticavity
Triclosan 0.30%	Antigingivitis

Uses aids in the prevention of:
· cavities · plaque · gingivitis

Warnings
Keep out of the reach of children under 6 years of age.
If more than used for brushing is accidentally swallowed, get medical help or contact a Poison Control Center right away.
Ask a dentist before use if you have
· bleeding or redness lasting more than 2 weeks
· pain, swelling, pus, loose teeth, or more spacing between teeth
These may be signs of periodontitis, a serious form of gum disease.

Helps Prevent: Cavities · Gingivitis · Plaque | Fights Tartar · Freshens

Colgat

Anticavity Fluoride and Antigingivitis Too

NET WT 6.0 OZ (170 g)

Questions

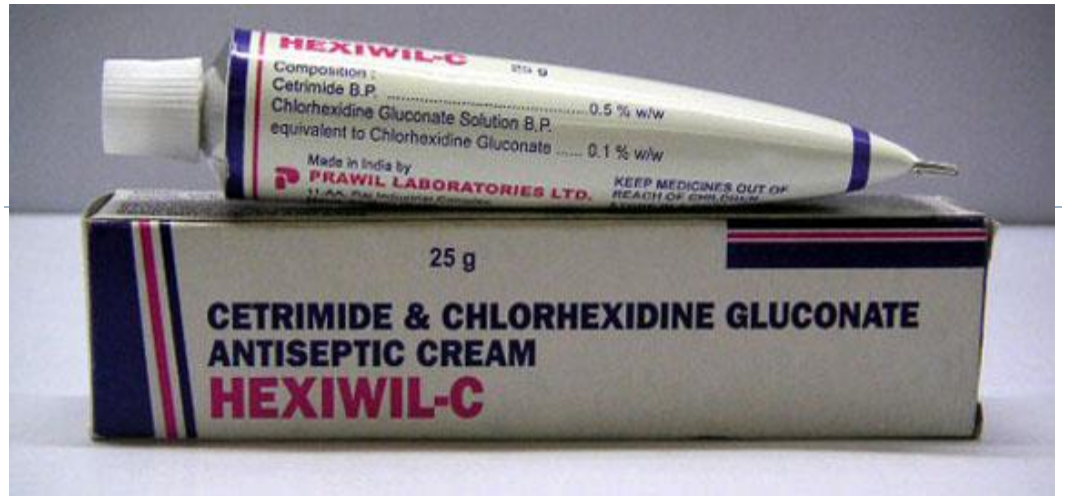
- What is the active ingredient in Dettol?
- Why it produces a white emulsion when diluted with water ?
- Why pine oil is added?

Types of compound: Surface-active agents

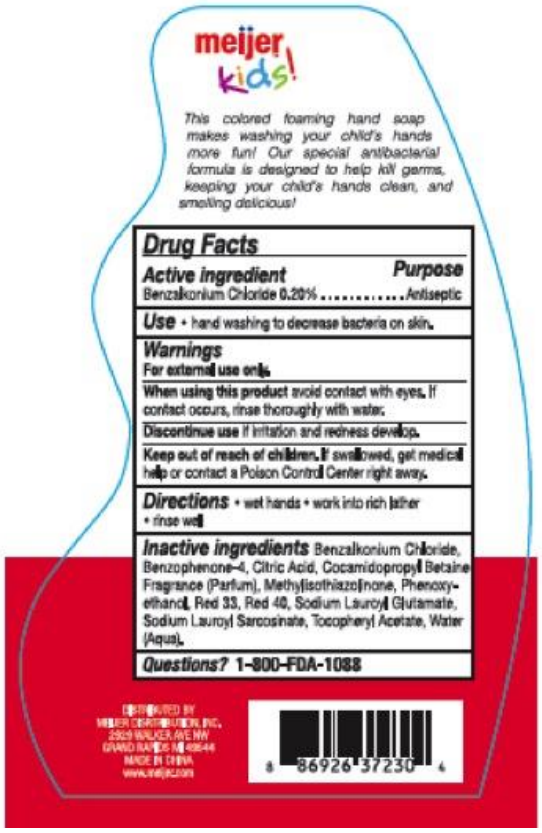
- Anionic and non-ionic surface active agents have strong detergent properties but exhibit little or no antimicrobial activity
- Ampholytic or amphoteric display both detergent properties of the anionic surfactant and the antimicrobial activity of the cationic agents→ hand scrubbing, medical instrument and floor disinfection in hospitals
- Cationic surfactant (quaternary ammonium compounds)→ most important role in antimicrobial:

- Benzalkonium chlorie
- Cetyltrimethylammonium bromide (cetrimide)


Cetrimide Cream BP


HEXIWIL-C
Composition :
Cetrimide B.P. .....
Chlorhexidine Gluconate Solution B.P. .....0.5 % w/w
equivalent to Chlorhexidine Gluconate .....0.1 % w/w
Made in India by
PRAWIL LABORATORIES LTD.
KEEP MEDICINES OUT OF REACH OF CHILDREN
25 g
CETRIMIDE & CHLORHEXIDINE GLUCONATE
ANTISEPTIC CREAM
HEXIWIL-C


meijer kids!
Paraben Free
Bright Colored Foam
antibacterial
foaming
hand soap
Cherry
10.1 FL OZ (298 mL)


meijer kids!
This colored foaming hand soap makes washing your child's hands more fun! Our special antibacterial formula is designed to help kill germs, keeping your child's hands clean, and smelling delicious!
Drug Facts
Active ingredient Purpose
Benzalkonium Chloride 0.20% ..... Antiseptic
Use • hand washing to decrease bacteria on skin.
Warnings
For external use only.
When using this product avoid contact with eyes. If contact occurs, rinse thoroughly with water.
Discontinue use if irritation and redness develop.
Keep out of reach of children. If swallowed, get medical help or contact a Poison Control Center right away.
Directions • wet hands • work into rich lather • rinse well
Inactive ingredients Benzalkonium Chloride, Benzophenone-4, Citric Acid, Cocamidopropyl Betaine Fragrance (Parfum), Methylisothiazolinone, Phenoxyethanol, Red 33, Red 40, Sodium Lauroyl Glutamate, Sodium Lauroyl Sarcosinate, Tocopheryl Acetate, Water (Aqua).
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Antimicrobial combinations

- All chemical agents have their limitations (antimicrobial activity, resistance to organic matter, stability, incompatibility, irritancy, toxicity, or corrosivity)
- Combination:

- Improve activity
- Reduce toxicity
- Synegistic

Table 19.7 Disinfection policies—classification of equipment according to risk

Risk level	Examples	Classification	Objective	Decontamination
High risk: critical items	Surgical instruments, implants, catheters	Objects which enter a sterile tissue or system	Sterility—all microorganisms killed including bacterial spores	Thermal or gaseous sterilization preferable. Chemical sterilization with aldehyde or peroxygen with extensive contact times
Intermediate risk: semicritical items	Endoscopes, cystoscopes, respiratory and anaesthesia equipment	Objects in contact with mucous membranes or broken skin	Free of all viable microorganisms except bacterial spores	High level disinfection with aldehyde or peroxygen; contact times up to 30 min
Low risk: non-critical items	Blood pressure cuffs, food utensils, furniture, floors	Objects in contact with intact skin but not mucous membranes	Some microorganisms remaining	Low-level disinfection using alcohols, chlorine, iodophor, QACs

QAC, quaternary ammonium compound.

Table 19.3 Antifungal activity of disinfectants and antiseptics

Antimicrobial agent	Time (min) to give >99.99% kill[a] of		
	Aspergillus niger	*Trichophyton mentagrophytes*	*Candida albicans*
Phenolic (0.36%)	<2	<2	<2
Chlorhexidine gluconate (0.02%, alcoholic)	<2	<2	<2
Iodine (1%, alcoholic)	<2	<2	<2
Povidone-iodine (10%, alcoholic and aqueous)	10	<2	<2
Hypochlorite (0.2%)	10	<2	5
Cetrimide (1%)	<2	20	<2
Chlorhexidine gluconate (0.05%) + cetrimide (0.5%)	20	>20	>2
Chlorhexidine gluconate (0.5%, aqueous)	20	>20	>2

[a]Initial viable counts *c.*1 × 10^6/ml in suspension test.