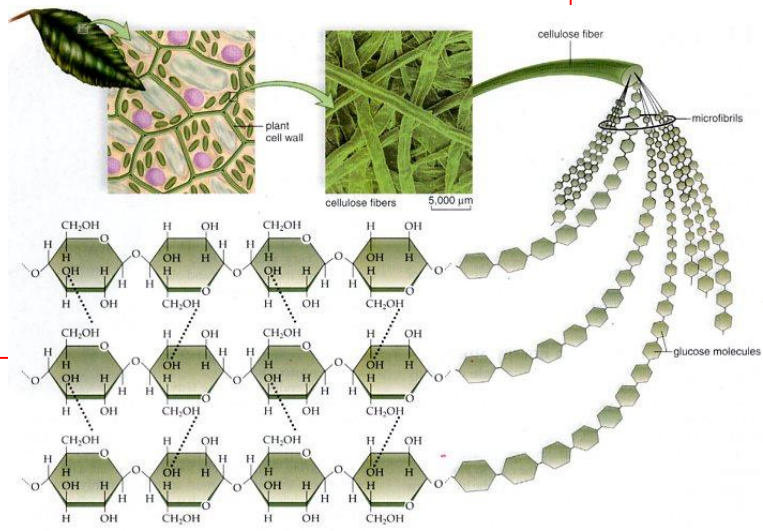
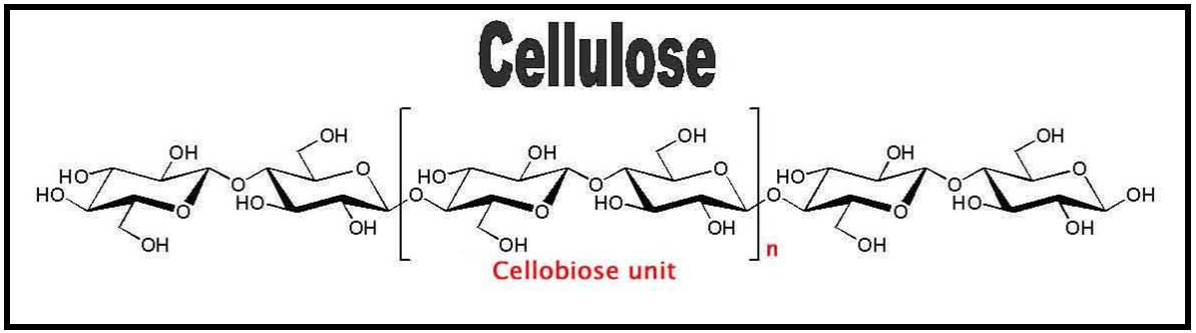
# CELLULOSE

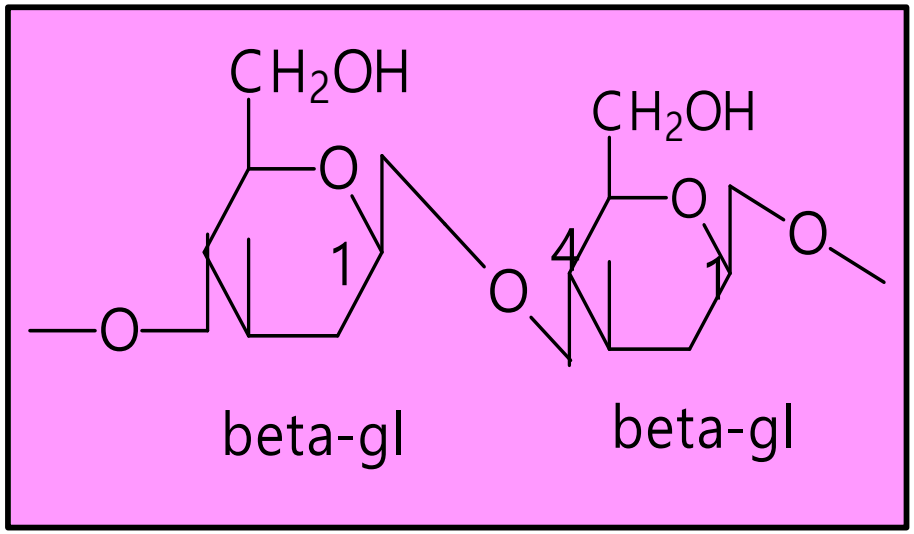
- **Cellulose is the most abundant biological polymer found in plants structure**
- **As a constituent of cotton, paper and wood**
- **Hemicellulose, lignin and silicic acid are found together with cellulose in cell wall**



- **Cellulose is a linear polymer of a few thousand $\beta$ –glucose molecules.**
- **MW 150.000–1.000.000**
- In higher plants especially a main constituent of meristematic tissue.
- Heating by acids resulted in disaccharide units; cellobiose

- **Two enzymes are important for degredation of cellulose:**
- **1) Cellulase : Degredation of cellulose to cellobiose molecules**
- **2) Cellobiase: Degredation of cellobiose to D-glucose molecules**
- **Cellulose....(Cellulase).....Cellobiose. ...(CELLCELLOBIASE)..... $\beta$ –glucose**






**Cellobiose**

# Identification

- **Does not give colour with $I_2$ . However if cellulose is reacted with $ZnCl_2$ (zinc chloride) or 70% $H_2SO_4$ previously, it will give blue colour with $I_2$-KI solution**
- **Insolubile in organic solvents**
- **solubile in SCHWEITZER reagent (Ammonium cupper salt solution)**

- **Cellulose is a linear polymer of β-1-4 linked glucose molecules, and the glycoside bonds are always equiatorial and the hydrogens are axial groups**
- **Insolubile in water**
- **Many microorganisms, ruminants and snail can digested cellulose**
- **Cellulose is eliminated from human body without digestion**
- **On the cell wall in the spaces between cellulose units, some polysaccharides such as pentosans, lignin (lignification) and $SiO_2$ (silification) can accumulate**

- **Hydrolisation of cellulose fibers is performed to shorten chain in the process of cellulose isolation**
- **Oxygen in the air/ sodium hypochlorite are the oxidation agents induce primary alcohol group to carboxyl group on the molecule**
- **Some preparations, are used in treatment of lipoidosis due to its high volume and low calorie content**

## Production

- Delignifying of wood+conc.alkaline/$CaSO_3$-----+acid addition-------- cellulose precipitates

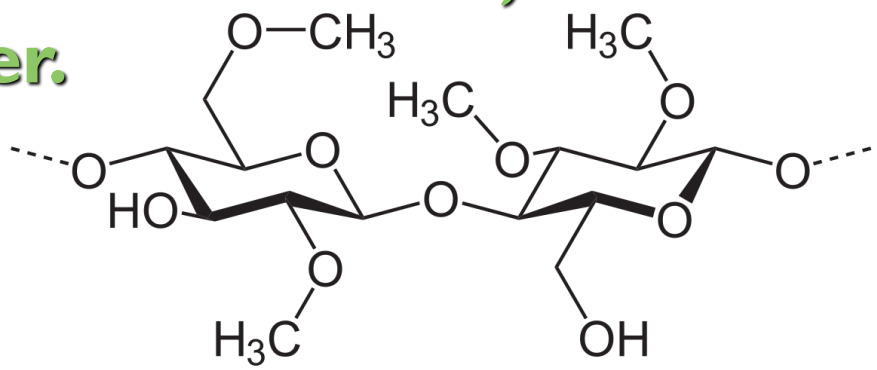
## Usage

- Cellulose is not used as its. Generally drugs containing cellulose and cellulose derivatives are used

## CELLULOSUM ACETYLATUM-PHTALYLATUM, ASETİL FİTALİL SELÜLOZ

- Estherification product of cellulose with asetic anhydride and ftalic acid anhiydride
- White, slippery powder and used for enteric coating
- Insolubile in water, due to free –COOH groups this compound is solubile in alkaline medium as its salt. Therefore used for preparation of enteric coated preparations
- Used in food industry, cosmetic industry, textile and paper industry

- **METHYLCELLULOSUM,**
- **METİL SELÜLOZ, TYLOSE, METHOCEL (MC), METHYL CELLULOSE**
- **Methyl ether of cellulose, containing 26-33% methoxyl goup**
- **Production:** Cotton/ wood cellulose +NaOH -------alkaline cellulose solubile in water+ methyl chloride (under pressure).... –OH groups are methylated, solubility decreased due to methylated groups. Easily solubile in cold water, insolubile in hot water.



- Different methylcellulose types are used for preparation of 2% solutions and 6 different types of MC (15,25,100,400,1500, 4000 cps) are prepared by adjustment of their viscosity
- MC whitish, fiber, powder or granule form.
- Insolubile in ethyl alcohol, ether and $CHCl_3$, solubile in iced $CH_3COOH$ and $EtOH:CHCl_3$ (1:1)

- Humectant
- Laxative
- Appetite suppressant
- 0.5-1% ophtalmic solutions as contact lens solutions
- Improve viscosity and stabilisation in pomade and lotions in pharmaceutical technology
- Suspension agent in procaine penicilline suspensions

- **ETHYLCELLULOSUM ,**
- **ETİL SELÜLOZ,**
- **ETHYL CELLULOSE**

- **Containing 45-51% etoxy groups**
- **Production: Alkaline solution+ethylchloide/ethylsulphate-----Ethylcellulose**
- **In pharmaceutical technology film coated tablets and as binder in tablets manufacturing**

- **HYDROXYETHYLCELLULOSE**
- **Hydroxyethylether derivative of cellulose**
- **Binder in tablet manufacturing and synthetic tears in some formulations**

## HYDROXYPROPYL METHYLCELLULOSUM

- **Propyleneglycol ether of methylcellulose**
- **Produced from methyl cellulose and 3 hydroxy propylchloride, and containing 20-30% –$OCH_3$, 3-12% hydroxypropyl.**
- **In ophtalmic solutions (at conc. 0.3-1%) used as synthetic tears in contact lens solutions**
- **Suspension agent**

- **HYDROXYPROPYLCELLULOSE**

Hydroxy propyl ether of cellulose

**Hydroxypropyl groups should be at least 80.5%**

Stabilisator in liquid preparations

**Binder in tablet manufacturing and film coated for tablets**

# MICROCRYSTALLINE CELLULOSE
# MİKROKRİSTAL SELÜLOZ,

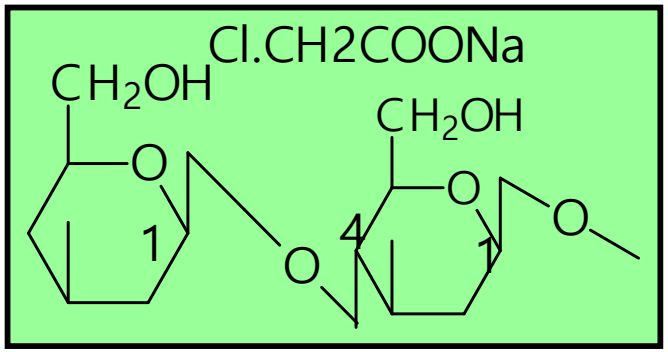
- Produced by partial depolymerisation and purification of $\alpha$ –cellulose
- Two different type ; Dispersable form in water with small granules, non–dispersable form in water with big granules
- Reaction conditions: 2.5N HCl and105 ºC for 15 min resulted in cellulose in crystalline form from its fiber form
- Obtained product-- filtered---+water --- water $NH_3$ neutralisation--------milled to obtain microcrystalline form

- Tablet manufacturing, stabilisator in emulsions and foams
- Adsorbent in column chromatography and TLC

- **CARBOXYMETHYLCELLULOSUM NATRICUM, SODYUM CMC, SODIUM CMC**
- **Polycarboxy methyl ether cellulose sodium salt**
- **Free –COOH groups constituted to form salt**
- **This salt hygroscopic and contains 7-8.5% Na, disperse easily in water**

- **Production:** Purified alkaline cellulose+ sodium salt of monochloracetic acid.
- Three different type:
- LOW VISCOSITY (25-50 CPS)
- MEDIUM VISCOSITY(400-600 CPS)
- HIGH VISCOSITY(1500 CPS)
- Odourless and tasteless

- **Laxative due to its hydrophilic specifications,**
- **Antacid due to its Na content**
- **1-2% solutions are used in dermatology. Excipient**



## CELLULOSUM OXYDATUM, OKSİTLENMİŞ SELÜLOZ, OXIDIZED CELLULOSE

- Obtained by oxidation of cotton or gauze by $NO_2$
- Oxidation of primary alcohol gr. in glucose molecules to carboxyl functional groups:
- $CH_2OH$---CHO----COOH
- If the COOH group content is higher than 16%; solubile in diluted alkaline solution in short time.
- Oxidized cellulose is haemostatic
- Used in surgery

# GOSSYPIUM DEPURATUM (TF), Hidrofil Pamuk, Absorbent cotton

- **deoiled, purified, bleached and sterilized fibers of *Gossypium* (Malvaceae) species seeds. Cellulose content is 88-90%.**
- **In the world 15 *Gossypium* species grow.**
- **In Turkey;**
- ***G.hirsutum* (Akala cotton)**
- ***G.herbaceum* (Yerli (Native) cotton)**

- ***G.barbadense* (Mısır (Egyptian) cotton)**

# GOSSYPIUM DEPURATUM (TP), Hidrofil Pamuk

- **Fruits are loculicidale capsule, contains 5-7 seeds covered with long white hairs**
- **Cotton is collected when the capsules are opened**
- **Long fibers are the indicators of cotton quality**
- **Raw cotton---deolied by diluted alkaline solution …..purified-----whitened by hypochlorite**
- **According to the EP fiber length should be at the most 4 cm and the thickness should be at the most 40 µ**

# GOSSYPIUM DEPURATUM (TP)

- **EP; "*Lanugo Gossypii Absorbens Aseptica*" sterile absorbent cotton.**
- **In surgery as hemostatic,**
- **Sterilisation of wounds**
- **Preparation of swab (drug containing cotton)**
- **Raw cotton keeps afloat while sterile cotton absorb the water and subside in boiled water. This test can be used for identification of the cotton whether it is raw or sterile.**

# GOSSYPIUM DEPURATUM (TP)

- **EUROPEAN PHARMACOPEIA;**
- **"Filum Lini Asepticum (Sterile Linen Fiber)"**
- **Sterile Polyamide-6 (in surgery)**
- **Sterile Polyamide 6/6 (in surgery)**
- **Sterile polyesther suture (in surgery)**

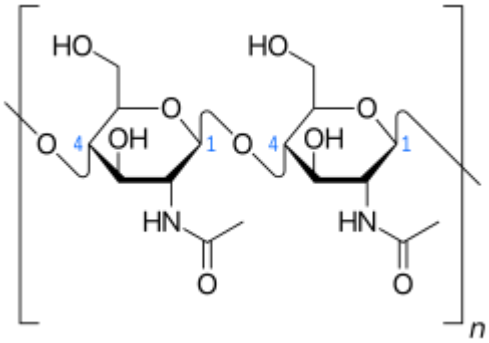
- ***Cellulosum Foliatum***: **Purified cellulose softened with water and then production of thin layers of felt by machine**
- **Due to its absorbent ability, is used for baby's nappy and adult diapers.**

- ***Piroksillin, Kolloksilin: (Pyroxilin)***
- Cotton+$HNO_3/H_2SO_4$-----nitration
- **Cellulose dinitrate/trinitrate/tetranitrate/ pentanitrate /hexanitrate**
- In ethylalcohol or other solutions keep as 30% solution
- **Used for production of colloidon and film coating**

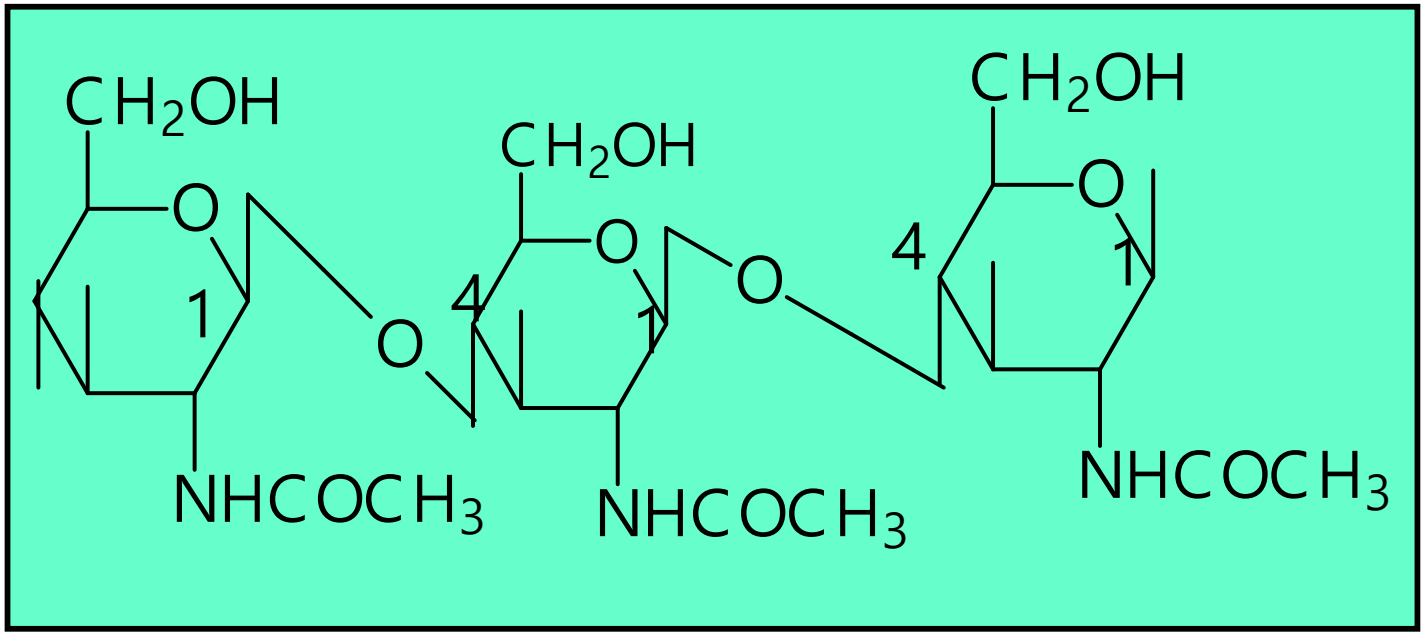
- ***Collodium, Kollodyon:***
- ***Collodion***
- **Pyroxylin solution in ethanol-ether mixture**
- **Colourless and syrupy liquid**
- **Film layer constituted on wound surface**
- ***"Collodium Elasticum Celluloid" is prepared with addition of 3% Ol.Ricini or 2% camphora to prevent cracking***
- **Used in surgery for sterilisation of some area**
- **Collodion containing salicylic acid used for treatment of callus.**

# CHITIN

- **Polymer similar to cellulose, containing β 1–4 bonded N–acetyl–D glucosamine chain**
- **Fungi, yeast, alg, marine invertebrates, arthropods contains**

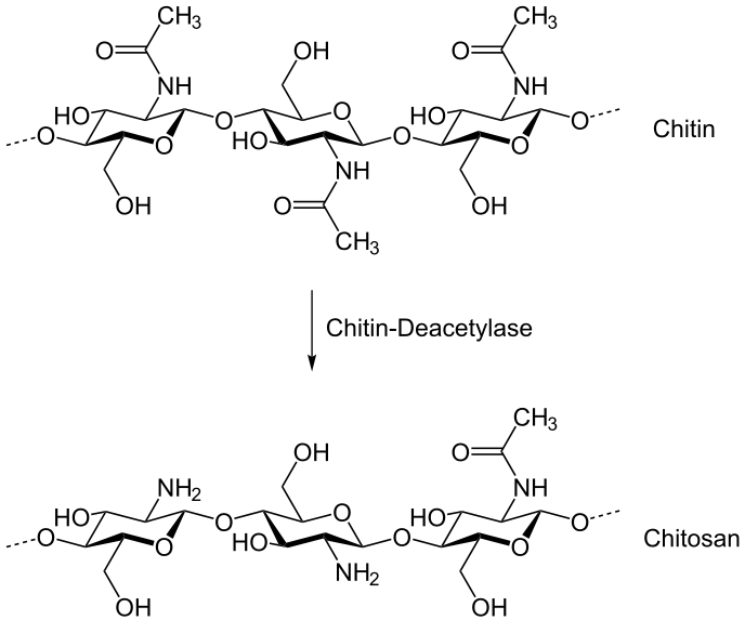


- **Insolubile in water, dil. acids, dil. and conc. alkaline solutions, alcohol and organic solvents**
- **Solubile in con.HCl, con.$H_2SO_4$, 78-97% $H_3PO_4$, anhydr HCOOH.**
- **Used for production of chitosan and glucosamine**


CH2OH
O
1
O
CH2OH
O
4
1
O
CH2OH
O
4
1
NHCOCH3
NHCOCH3
NHCOCH3

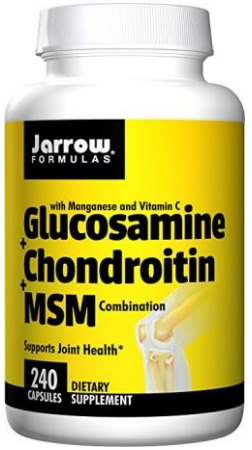
# CHITOSAN

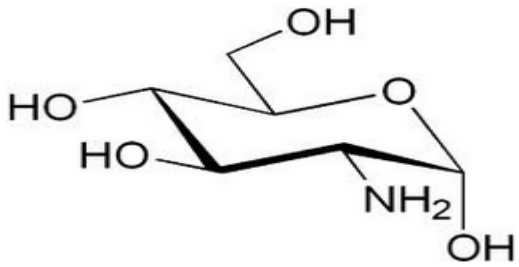
- **Linear polysaccharide deacetylated chitin structure**
- **Preparation of drugs for weight loss In emulsions**
- **Stynthetic fibers and textile dyeing**



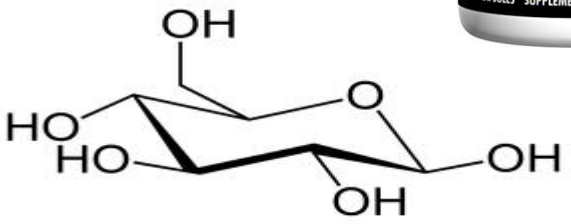
# GLUCOSAMINE

- 2 amino, 2 deoxy $\beta$ -D-glucopyranose
- Found in Chitin, mucoprotein and mucopolysaccharides
- Obtained from chitin and by synthesis
- Antiarthritic (Attention for diabetic patients !!)
- In treatment of rheumatic diseases used as $SO_4$ and HCl salt




Glucosamine




Glucose (Sugar molecule)

# MANNAN

- **Plant polysaccharide is a linear polymer of the sugar mannose bonded β 1-4 linkages**
- **Constituent of the cell structure together with cellulose**
- **Many of seed endosperms contain as supplement material. Such as *S.Arecae*/ *S.Coffeae*/ *S. Hippocastani* etc.**

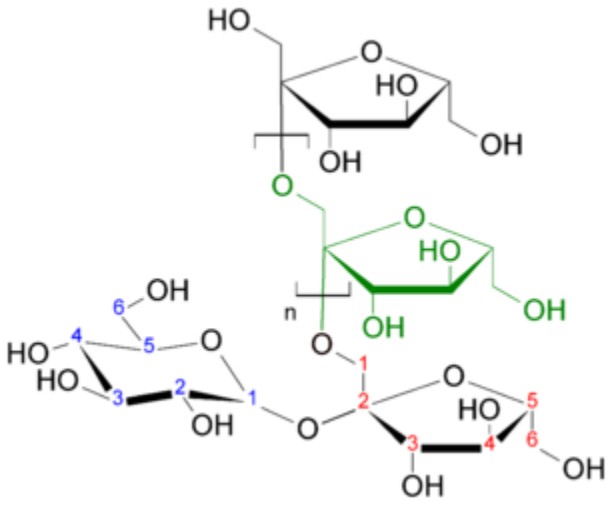
# MANNAN

- **Hemicellulose composed of-------xylan+mannan**
- **Tubera Salep contains in its mucilage**
- **Laxative in pediatry**

# FRUCTANS

- **Homogenous linear polysaccharides containing fructofuranose molecules which are β 1-2 bonded**
- **INULIN is the most important**

- ***Inula* radix and rhizoma contains (Compositae) -------45%**
- ***Lappa*----------45%**
- ***Taraxacum* ----------25%**



- *Dahlia* and *Helianthus* tubers
- *Pyrethrum* and *Cichorium* roots
- *Asparagus officinalis*
- Inulin is solubile in hot water and precipitates in cold water
- Dissolved in cellulary juice (Difference from starch)
- In human disintegrated to fructofuranose molecules
- Nutrient for diabetic patients (preparation of bread and some other products)

- **Usage:**

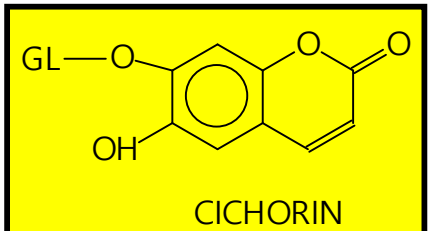
- Production of fructose
- **Kidney function test**
- Identification of some microorganisms in bacteriology
- **Nutrient for diabetic patients**

# OTHER FRUCTANS

- ***Urginea maritima*---- fructo-oligosaccharides (1-2 bonded)**
- ***Iris sp.*---------- (1-2 bonded)**
- ***Agropyrum repens*------- (1-2 and 2-6 bonded)**

# CICHORIUM INTYBUS, HİNDİBA, CHICORY (Compositae)

- Used parts are radix
- **Widely found, with blue colour flowers, perennial and herbaceous plant**
- Native to Mediterreneaen
- Inulin
- **Resin**
- Volatile oil
- **Cichorin** (Coumarin)
- Chlorogenic acid
- Sesquiterpene lactons
- Fatty acids



CICHORIN

- **USAGE**
- **Production of inulin**
- **As coffee after roasted**
- **Inulin caramelized after roasting. Because of the oxymethylfurfural smells like a coffee**
- **Roots are diuretic,  laxative, diaphoretic, appetizer, tonic, antifungal, choleretic and colagogue, to facilitate urinary and digestive elimination functions, to enhance elimination of renal water, as an adjunct in weight loss diets**

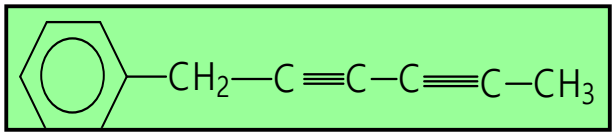
# RHIZOMA GRAMINIS, Couch Grass Rhizome, AGROPYRI REPENTIS RHIZOMA

- *Agropyrum repens (Triticum repens)* (Graminae) dried underground parts
- Perennial, 30-120 cm height and herbaceous
- Grows naturally; In Europe and Anatolia roadside and fields
- South part of USA, Australia and New Zealand

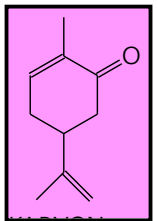
# RHIZOMA GRAMINIS

- The shiny yellowish, light brown or yellowish brown rhizome and stem pieces are hollow, longitudinally furrowed and about 2-3 mm thick. At the unthickened nodes are the remains of very thin, more or less branched roots and fiber-like scales. The taste is bland and slightly sweet


- **Contents:**
- **3-18% Triticin (similar to inulin)**
- **3% D-fructose**
- **Mucilage and gum**




- **0.01-0.05% volatile oil (95% Agropyren+ 5% carvon) agropyren is antimicrobial agent**



# RHIZOMA GRAMINIS

- **Usage:**
- **Nutrient in diabetic patients**
- **Laxative**
- **2% decoction is diuretic**
- **Uriner tract infections and against kidney stones**

# LICHENIN, ISOLICHENIN

- ***Cetraria islandica*** **(Iceland moss)------**

**Lichen Islandicus**

- **Grows in North Europe mountains, north of USA and Himalayas**
- **50% polysaccharides solubile in water**
- **LICHENIN; polymer containing 60-200 β-D-glucose molecules bonded 1-3, 1-4 glycosidic linkage. Linear chain similar to cellulose**

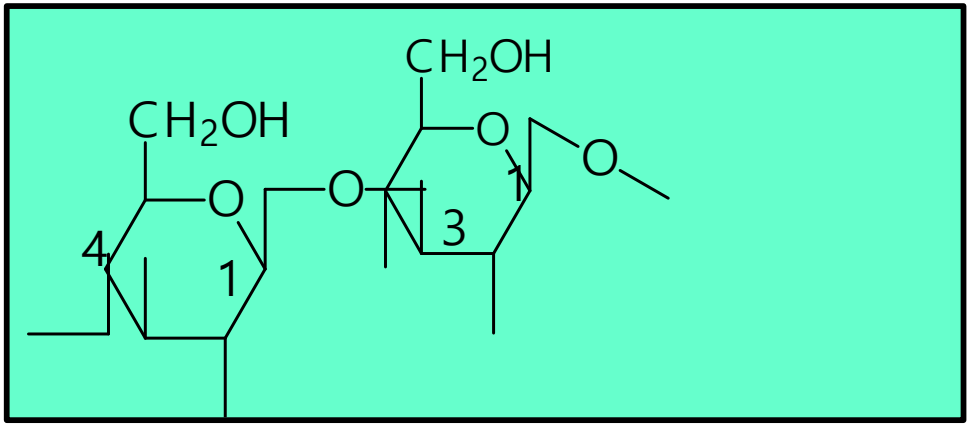
# LICHENIN, ISOLICHENIN

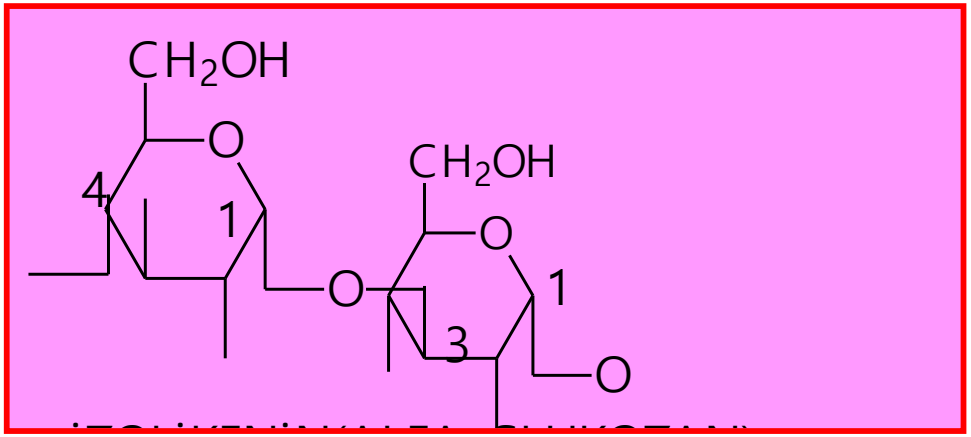
- **ISOLICHENIN:** Polysaccharide containing 42-44 α-glucose molecules bonded 1-3, 1-4 glycosidic linkage. Linear chain similar to amylose

**Lichenin solubile in hot water**, isolichenin solubile in cold water

**Lichenin does not give blue colour with iodine while isolichenine gives blue colour**

# LICHENIN, ISOLICHENIN



# LICHENIN, ISOLICHENIN

**Both polysaccharides do not have usage in pharmacy**

**However LICHEN ISLANDICUS thallus are used for their demulcent activity. Polysaccharides have protective effects on upper respiratory tract infections**

**COM.E approved its usage in cough, bronchitis, dyspepsy, mouth and pharynx and loss of appetite**

**As infusions and cold macerations are used**

# LICHEN ISLANDICUS

- **Infusion--------4-6 g drug+150 ml water**
- **Liquid extract----------1:1 (g/ml)-------4-6 ml**
- **Tincture---------1:5 (g/ml)----20-30 ml**
- **Is not used in stomach and duodenal ulcer originated from irritation of mucous membrane**

# RADIX ECHINACEAE/ HERBA ECHINACEAE (Coneflower)

- ***Echinacea purpurea*-----aerial parts and roots**
- ***E. angustifolia***
**(Compositae=Asteraceae)**
- ***E. pallida***
- **Collected plants in flowering time**
- **Native to USA**
- **Culture in Europe**
- **Do not grow naturally in Turkey**

# RADIX ECHINACEAE/ HERBA ECHINACEAE

- **Content**
- **Polysaccharides (Heteroxylan/ Arabinogalactan)**
- **Inulin type fructosan**
- **Alkamides**
- **Caffeic acid derivatives (Cichoric acid, caftaric acid echinacoside (not found in E. purpurea))**
- **Volatile oil**
- **Flavonoids**
- **Cu, Fe minerals**
- **A,C,E vitamins**

# RADIX ECHINACEAE/ HERBA ECHINACEAE

- **ACTIVITY**
- **Immunostimulant due to polysaccharides**
- **Arabinogalactan------increasing production of interferon, prevent proliferation of virus**
- **Alkamides------stimulate phagocytosis activation of macrophage, and inhibited prostaglandins**
- **Caffeic acid derivatives have anti-inflammatory and antioxidant activities**

# RADIX ECHINACEAE/ HERBA ECHINACEAE

- **USAGE**
- Cold and upper respiratory tract infection(*E. purpurea*)
- Urinary system infections (*E. purpurea*)
- Frequently recurrent infections (*E. pallida*)
- Flue (*E. pallida*)
- Cough and bronchitis(*E. pallida*)
- Mouth and pharynxh infections, aphta and herpes infections
- Burns and wounds
- Daily dosage 900 mg extract, 1-2 g drug
- Tincture (1:5 g/ml EtOH %55)

# RADIX ECHINACEAE/ HERBA ECHINACEAE

- Drop is the most active form
- Against frequently recurrent infections daily 2-3 times 10-20 drop (30-60 drop)
- Maximum 8 weeks
- **CONTRAINDICATIONS**
- **Due to its stimulating activity of immune system is not suitable in autoimmun diseases such as LUPUS**
- tuberculosis
- AIDS
- MS (Multipl sklerozda)

# RADIX ECHINACEAE/ HERBA ECHINACEAE

- **Compositae family allergy**
- **Allergic people**
- **Pregnancy and lactation - not suitable for usage**
- **In children doctors should advised**
- **Preparation that composed just Echinaceae or combination with other plants can be obtained commercially**