

13. FOOD ADITIVES

increased food quality
legislation

- **prolonging shelf life**
food preservatives
- **adjusting aroma and taste**
fragrant and taste compounds
alternative sweeteners
acidulants and regulator of acidity
bitter compounds and stimulating compounds
aroma intensifiers
- **compound adjusting colour**
colours
bleaching agents
- **compound adjusting texture**
thickening and gelatinous agents
emulsifiers
- **compounds enhancing biological value**
(nutritional factors, biological supplement)
vitamins
minerals
nutraceuticals
- other additives

indication

examples of indication

E200	sorbic acid
E210	benzoic acid
E220	SO ₂
E221	(Na ₂ SO ₃)
E222	(NaHSO ₃)
E223	(K ₂ S ₂ O ₅)

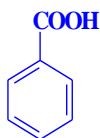
Food preservatives

permitted in CZ (book 3, tab. 11.3.)

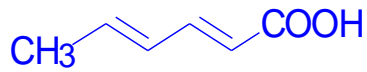
acids and their derivatives

benzoic acid, benzoates (salts)

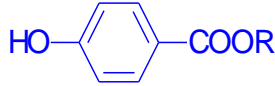
antimicrobial spektrum (book 3, tab. 11.1.)



sorbic acid, (2E,4E)-2,4-hexadienoic acid, and its salts



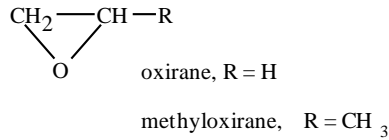
parabens (alkyl esters of *p*-hydroxybenzoic acid)
antimicrobial spektrum (book 3, tab. 11.2.)



R=Me, Et, Pr, Hp
 other acids

- formic
- acetic
- propionic
- lactic
- fumaric and other (some are classified as acidulantes)

alkylenoxides



H⁺, Cl⁻



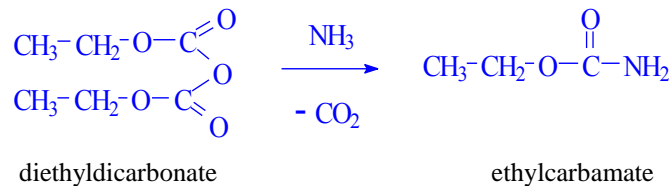
2-chloroethanol, R = H

2-chloropropan-1-ol, R = CH₃

1-chloropropan-2-ol, R = CH₃

dialkyldicarbonates

dimethylester (E242) is permitted for wine treatment



antibiotics

mostly bacteriocins (lactic acid bacteria)

nisin (polypeptide), (*Streptococcus lactis*),

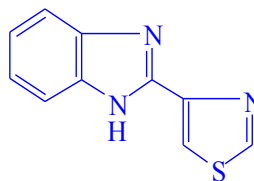
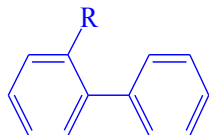
natamycin (pimaricin, macrolide), (*S. lactis*, *Streptomyces natalensis*)

enzymes

lysozyme (activity of neuramidase)

fungicides

biphenyl (R=H), *o*-phenylphenol (biphenylol), (R=OH), thiabendazole



inorganic compounds

sulfur dioxide, sulfites
 nitrites
 boric acid, boritans
 NaCl

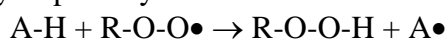
Natural compounds with anti-microbiologically activity

factors pH
 solubility
 temperature
 reactivity
 commodity

formic acid	B (germs)
propionic acid	P
nisin (polypeptide)	B
alkylenoxides	B, K, P
biphenyl, thiabendazole	P (moulds)
natamycin (P, K)	
diethyldicarbonate	K (yeasts)
nitrites	B (<i>Clostridium</i>)
lysozyme	B

antioxidants

mechanism of activity of primary antioxidants



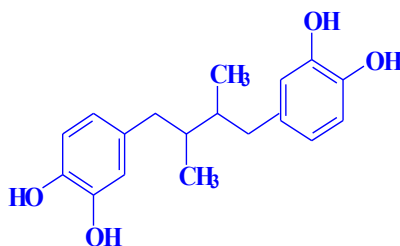
permitted in CZ (book 3, tab. 11.8)

natural

presence in food commodities (book 3, tab. 11.4)

tocopherols

NDGA (nordihydroguaiaretic acid)



ascorbic acid and its derivatives

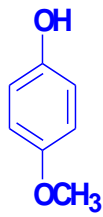
phenolic acids esters, flavonoids, spice extracts

synthetic

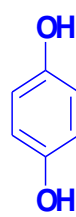
gallates (polar)
phenols (non-polar)



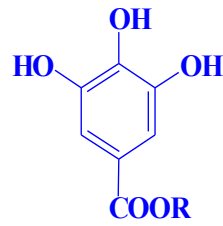
4-hydroxytoluene



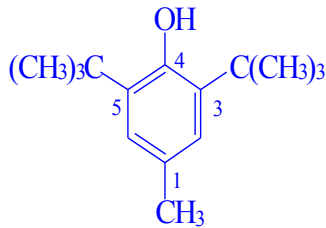
anisole



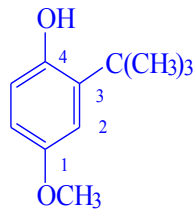
hydroquinone



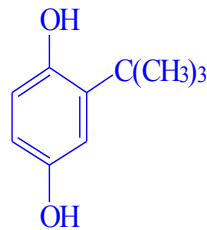
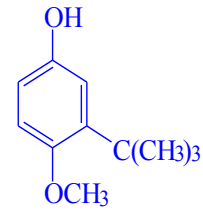
gallate



BHT
 3,5-di-tert. butyl-4-hydroxytoluene



BHA
 2- or 3-tert. butyl-4-hydroxyanisole



TBHQ
 2-tert. butyl-1,4-hydroquinone

polar
 unpolar

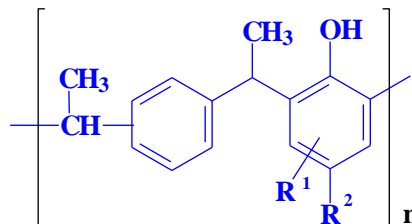
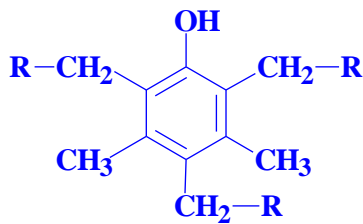
gallates
 phenols

for pure fats
 for emulsions (margarine)

nonvolatile
 non resorbed

for diets

for long-lasting industrial frying



$R^1 = \text{OH or OCH}_3$
 $R^2 = \text{H nebo alkyl}$

carry through effect

fragrant and gustatory compounds (aroma compounds)

natural toxic compounds suitable for aromatisation (book 3, tab. 11.9)
 highest amount permitted (book 3, tab. 11.10)

examples

sweet woodruff (*Asperula odorata*)
 yellow sweet clover (*Melilotus officinalis*)

haulm
 haulm

coumarine
 coumarine

plum (<i>Prunus</i>)	seed	coumarine
sweet vernalgrass (<i>Anthoxanthum odoratum</i>)	stem	coumarine

origin of fragrant compounds

75 % natural, 25 % synthetic: 99 % in nature, 1 % does not occur in nature

materials	oleoresins	
	extracts, juices, pulps, distillates	
	essential oils	- absolute
		- deterpenated
		- reconstituted
	fresh parts of plants	
	dried or in other way adjusted parts of plants = drugs	

biological effects

- beneficial effects
 - bactericidal and antiinflammatory effects (borneol, eugenol, pinene, camphor, thymol, menthol)
 - spasmolytic or cholinolytic effects (camphor, camphene, α - and β -pinene)
 - analeptic effects (camphene)
 - antioxidative effect (essential oils from many spices: majoram, sage, thyme)
- toxic effects
- chronic neurotoxicity (spasms and lesion of cerebral cortex)
 - α -thujone a β -thujone = dominant component
 - wormwood essential oil
 - sage essential oil
 - pyrethrum essential oil
 - yarrow essential oil
 - (+)-pulegon (essential oils of different type of mints)
- carcinogenic activity - alkenylbenzenes
 - β -asarone (calamus root essential oil)
 - estragol (tarragon essential oil)
 - methyleugenol (clove essential oil)
 - safrol (nutmeg, cinnamon essential oils)
 - isosafrol (laurel, clove essential oil)
 - myristicin (essential oils of vegetables: carrot, parsley, celery, caraway)
- psychomimetic, halucinogenic a narcotic effects (comparable with effects of ethanol)
 - myristicin
- hepatotoxic effects
 - coumarin

Alternative sweeteners

permitted in CZ (book 3, tab. 11.13)

relative sweetness (book 3, tab. 11.11, 11.12)

- natural (thaumatin, stevioside)
- synthetic identical with natural compounds or modified natural compounds (sugar alcohols, neohesperidindihydrochalcon)
- synthetic (saccharin)
- nutritive (aspartam, monellin) 10 kJ (2,4 kcal)/g
- non-nutritive (rest of sweeteners)

according to legislation

monosaccharides
disaccharides
sugar alcohols are not additives

synthetic non-nutritive sweeteners

natural compounds **glycosides**

glycyrrhizin (saponin), (root of liquorice, *Glycyrrhiza glabra*)
stevioside (leaves of *Stevia rebaudiana*)

seed proteins

monellin (*Dioscoreophyllum cummuisii*, tropical tree)

thaumatin (*Thaumatococcus danielli*, tropical tree)



sweet peptides

miraculin (*Richardella dulcificum*, tropical tree), acidic taste sweet taste

acidulants and acidity regulators

permitted in CZ (book 3, tab. 11.14, 11.15)

- **acids**

acid taste and other properties

antimicrobial effects (propionic acid, acetic acids and other acids)

different taste possibly aroma (succinic acid , acetic acid and other acids)

stabilisers of colours (ascorbic acid, citric acid)

sequestrants (ascorbic acid, citric acid, EDTA, H₃PO₄) and other acids

influence on texture (citric acid)

suppression of turbidity formation (lactic acid)

- **acids derivatives**

salts (carbonates)

lactones (δ-gluconolactone)

- **salts with buffer activity, alkali**

increase of meat water-holding capacity

melting salts in cheese technology

olive debittering

fruits and vegetables peeling

bitter and stimulating compounds

organic and inorganic compounds

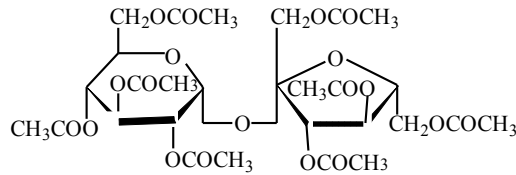
additives

- **octaacetylsaccharose**

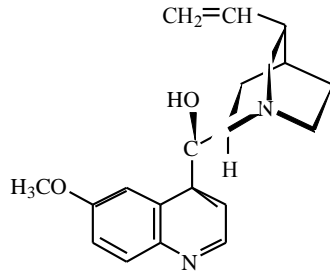
- **coffeine**

- **quinine**

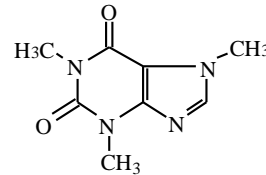
other plant compounds, hops, wormwood: belong to fragrant and taste compounds (aroma) compounds



octaacetylsaccharose



quinine



caffeine

non alcoholic drinks
alcoholic drinks

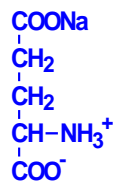
75 mg/l
300 mg/l

250 mg/l
necessary amount

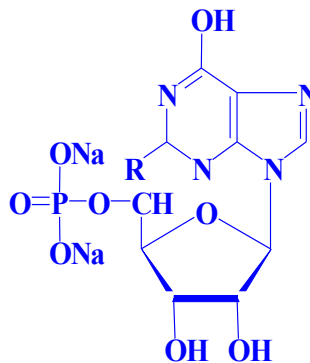
aroma intensificators

permitted in CZ (book 3, tab. 11.17)

natural intensificators, content in food (book 3, tab. 11.16)



sodium-hydrogen glutamate
(UMAMI)



5'-ribonucleotides

R=H
R=NH₂
R=OH

IMP
GMP
XMP

Colouring matters

- natural

- riboflavin
- carotenoids
 - β-carotene
 - β-apo-8'-carotenal
 - canthaxanthin
 - bixin
 - crocetin
 - curcumin

betacyans
 carmine (cochineal)
 chlorophyllide - Cu (II)
 caramel

permitted in CZ (book 3, tab. 11.19)

● **synthetic identical with natural synthetic**
 water soluble
 permitted in CZ (book 3, tab. 11.18)
 fat soluble

17 ČR

9 USA

monoazo colours

Amaranth (Victoriarubin)
 Yellow SY
 Tartrazine (yellow)
 Ponceau 4R (cochineal red)

diazo colours

Brilant black

indigo colours

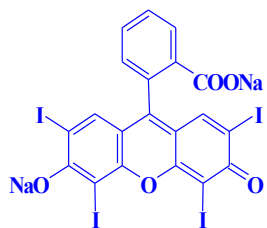
Indigotine (blue)

xanthene colours

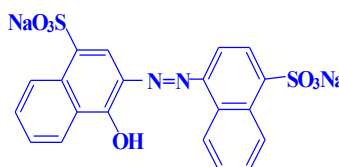
Erythrosine (red), contains iodine

diaminotriphenylmethane colours

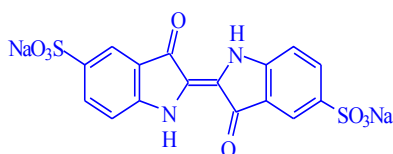
Patent blue



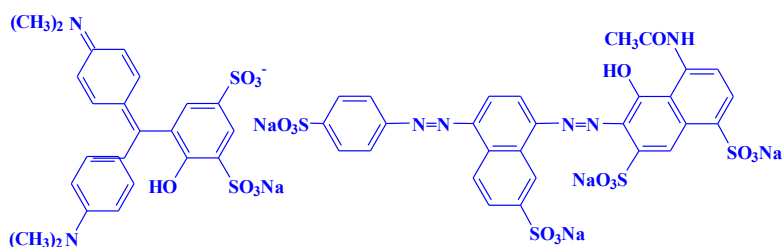
Erythrosine



Azorubine



Black BN



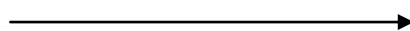
Green S

Indigotine

bleaching agents

oxidation or reduction

coloured



colourless

● **oxidative agents** (with active oxygen or chlorine)

ClO^-

Cl_2

BrO_3^-

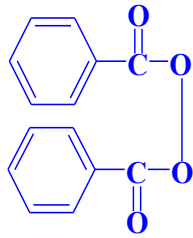
ClO_2

H_2O_2

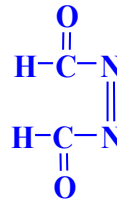
dibenzoylperoxid

- **reduction agents**

azodicarbonamide



dibenzoylperoxide



azodicarbonamide

thickening, jelling and swelling agents, binders, fillers

consistency, texture

permitted in CZ (book 3, tab. 11.21)

- **natural**

- plant polysaccharides (pectin)
- algal polysaccharides (agar, alginate, carrageenans)
- plant gums (Arabic, tragant)
- proteins (gelatin)

- **natural modified**

- polysaccharides (starch, cellulose)
- modified cellulose

- hydrolysed

- microcrystalline cellulose
- parcial hydrolysis by HCl, fibre, low-energy fillers, aroma carrier

- derivatised

- ethers
- carboxymethylcellulose (Na salt)
- methylcellulose
- hydroxypropylcellulose
- thickening, stabilisers of emulsions, ice decelerators

modified starches

- transformed (converted, degradated)
- polymerised
- stabilised
- modified by other means

emulsifiers

permitted in CZ (book 3, tab. 11.23)

hydrophobic part

hydrophylic part (anion, cation, amphoteric)

non-ionogenic

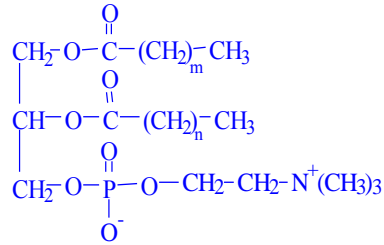
ionogenic (anion-active, cation-active)

HLB (book 3, tab. 11.22)

non-polar = 1
polar = 20

natural

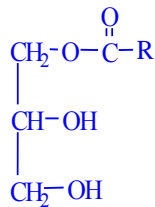
phospholipids (lecithin) ionogenic
monoacylglycerols non-ionogenic



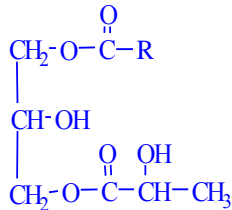
choline (main compound)

synthetic

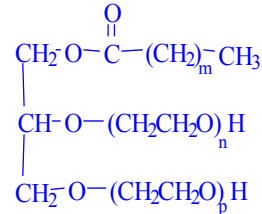
glycerol esters and their derivatives (polyglycerols)



monoacylglycerol

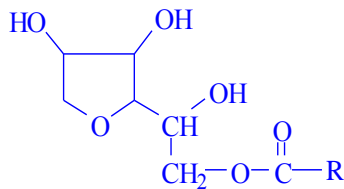


esters with lactic acid

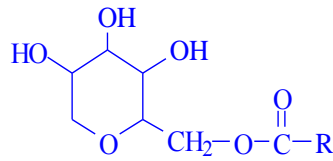


ethers with ethylenoxide

sorbitan esters

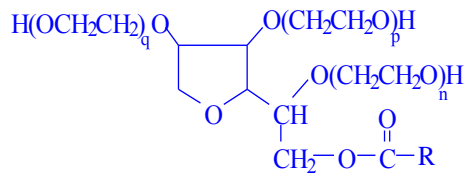


1,4-sorbitan ester



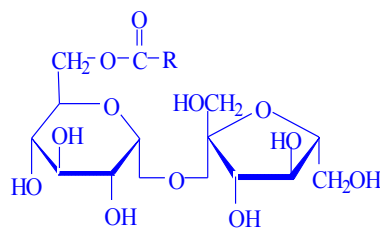
1,5-sorbitan ester

Spans



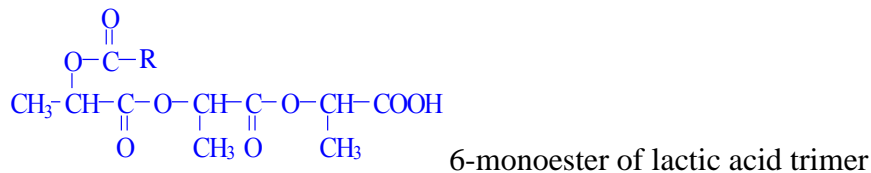
Tweens

saccharose esters



saccharose monoester

hydroxyacids esters



other additives

- firming
cell walls, fruits and vegetables (CaCl₂)
- enable formulation of products
carriers of aroma compounds (starch, dextrans, cyclodextrins)
fillers (polysaccharides)
adhesive compounds (starch, dextrans, phosphates)
surface modification agents (waxes)
softening agents (monoacylglycerols, oils)
- auxiliary agents
antisintering agent (SiO₂)
catalysts (Ni, MeONa)
clarifiers (gelatin, tannin, polyvinylpyrrolidone)
turbidity forming agents (gums, oils/Br, citrus peels)
dispersion stabilisers (Arabic gum)
foaming agents (surface active compounds, NO, saponins)
defoaming agents (surface active compounds)
lubricants and releasing agents (starch, MgSiO₄)
sequestrants (chelating agents)
packaging gasses
 - synergists and potentiators
 - propelants
 - solvents