

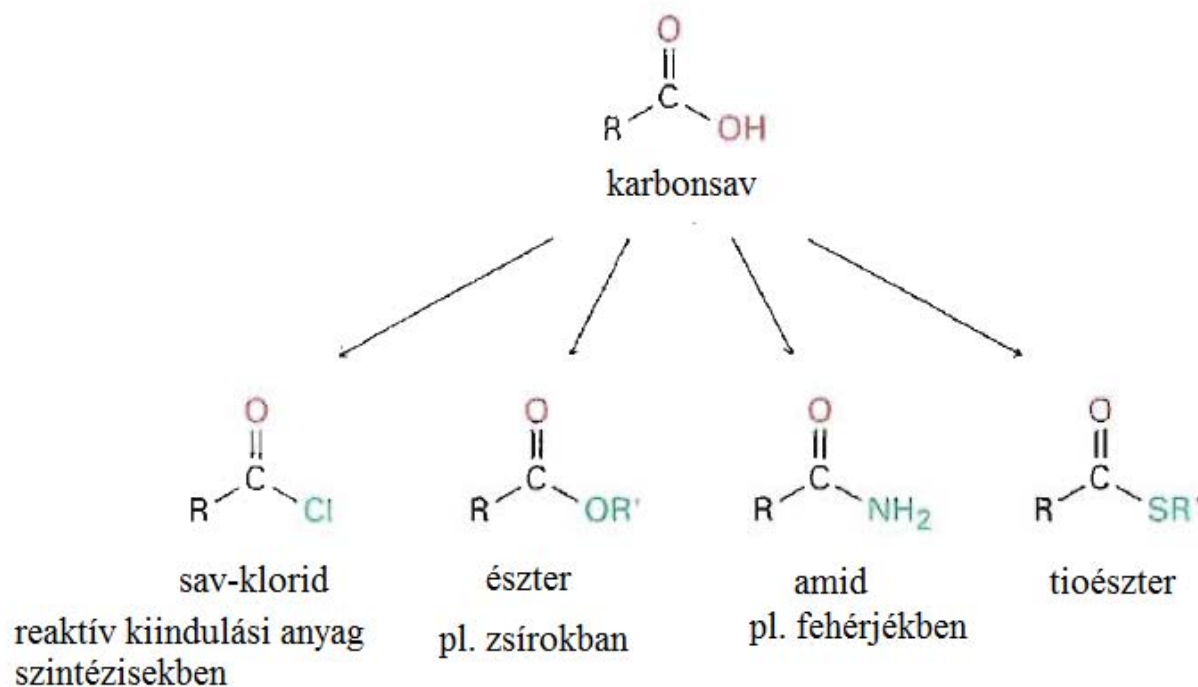
Oxigéntartalmú szénvegyületek

II. - karbonsavak

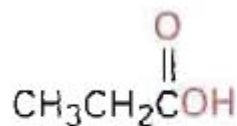
5. előadás

Karbonsavak

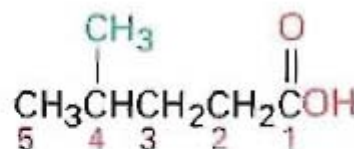
- Funkciós csoport: -COOH (karboxil)
- Rengeteg vegyület kiindulópontja
- Élettanilag fontos vegyületek (anyagcsere-folyamatok, zsírok)



Karbonsavak elnevezése

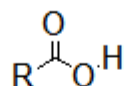


Propanoic acid



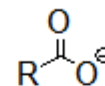
4-Methylpentanoic acid

sav

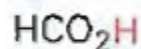


- H

savmaradék
(át)



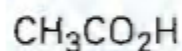
acil-csoport
(il)



hangyasav

formiát

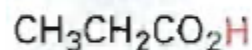
formil



ecetsav

acetát

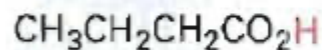
acetyl



propánsav

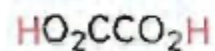
propionát

propionil



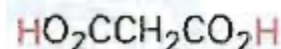
butánsav / vajsav

butirát



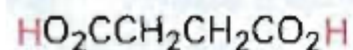
etán-disav / oxál(ecet)sav

oxalát



propándisav/malonsav

malonát

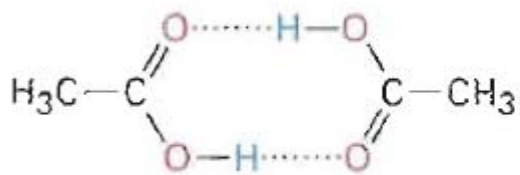


butándisav / borostyánkősav

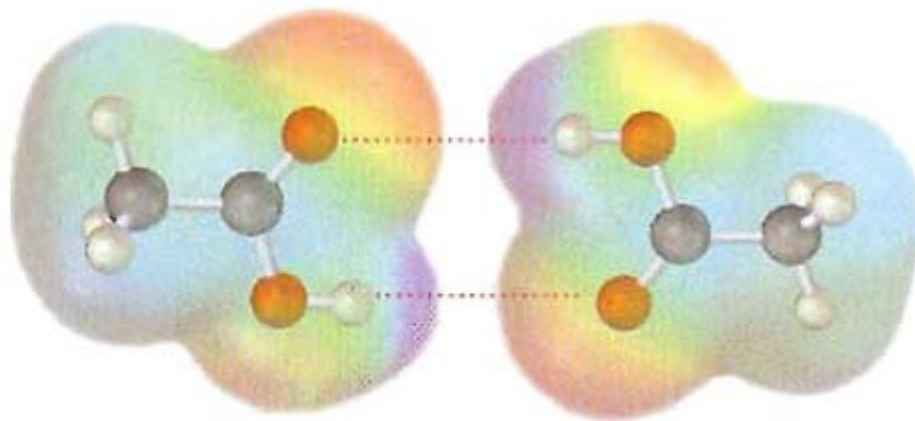
szukcinát

Karbonsavak fizikai tulajdonságai

- dimerizálódnak, H-híd kötéssel



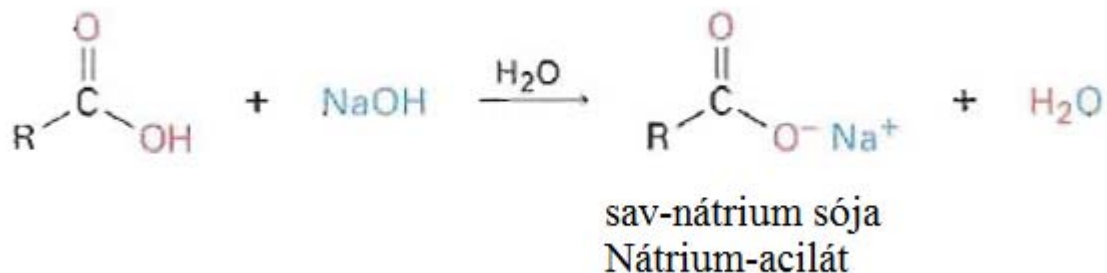
Acetic acid dimer



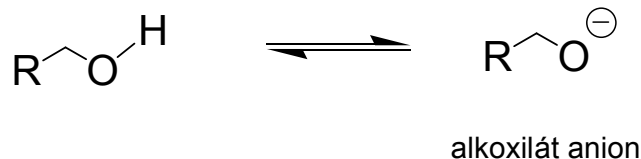
- a kisebbek vízoldékonyak, a C-lánc hosszával ez csökken
- magas op, fp.

Sav-bázis tulajdonság

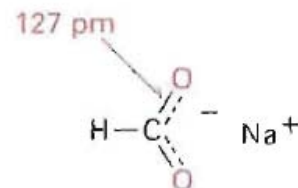
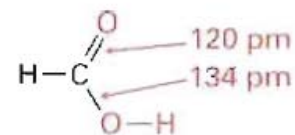
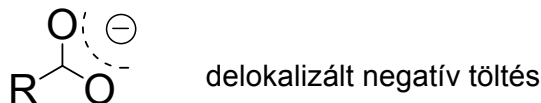
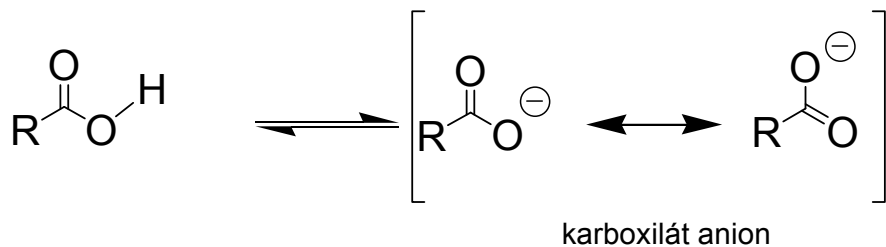
- Savként viselkednek, bázisokkal sókat képeznek



- Miért erősebb savak, mint pl. az alkoholok?




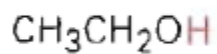
Stabil anion keletkezik (karboxilát)





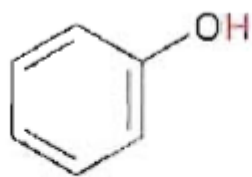
$$K_a = \frac{[\text{RCO}_2^-][\text{H}_3\text{O}^+]}{[\text{RCO}_2\text{H}]} \quad \text{and} \quad \text{p}K_a = -\log K_a$$

CF ₃ CO ₂ H	0.59	0.23	erősebb sav	
HCO ₂ H	1.77 × 10 ⁻⁴	3.75		
HOCH ₂ CO ₂ H	1.5 × 10 ⁻⁴	3.84		
C ₆ H ₅ CO ₂ H	6.46 × 10 ⁻⁵	4.19		
H ₂ C=CHCO ₂ H	5.6 × 10 ⁻⁵	4.25		
CH ₃ CO ₂ H	1.75 × 10 ⁻⁵	4.76		
CH ₃ CH ₂ CO ₂ H	1.34 × 10 ⁻⁵	4.87		
CH ₃ CH ₂ OH (ethanol)	(1.00 × 10 ⁻¹⁶)	(16.00)		gyengébb sav



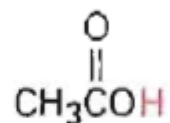
$pK_a = 16$

etanol



$pK_a = 9.89$

fenol



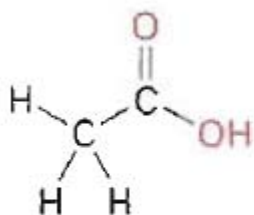
$pK_a = 4.76$

ecetsav

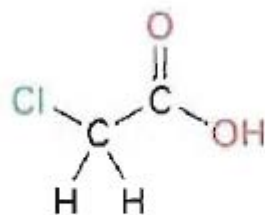


$pK_a = -7$

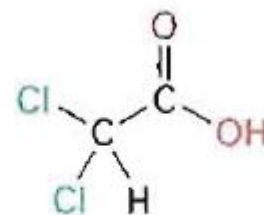
sósav



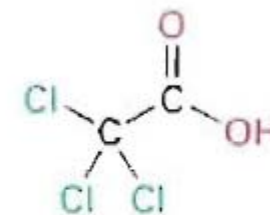
$pK_a = 4.76$



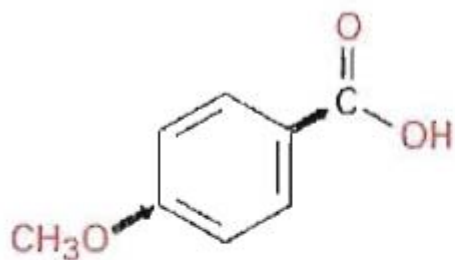
$pK_a = 2.85$



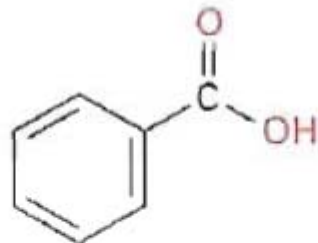
$pK_a = 1.48$



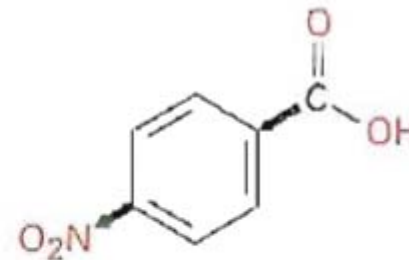
$pK_a = 0.64$



p-Methoxybenzoic acid
($pK_a = 4.46$)



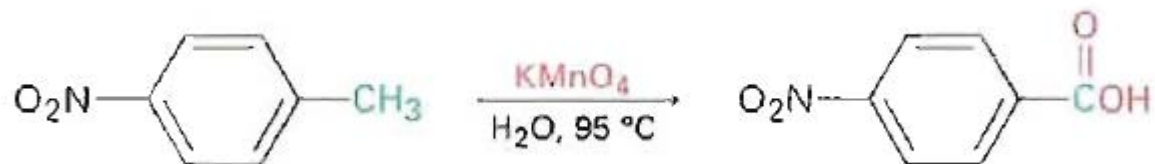
Benzoic acid
($pK_a = 4.19$)



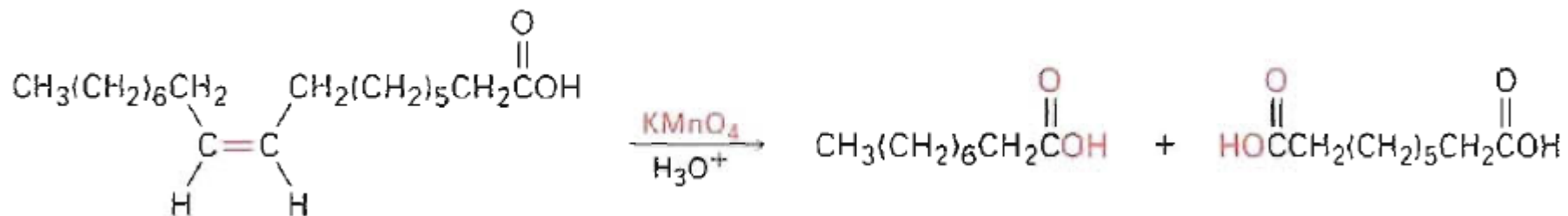
p-Nitrobenzoic acid
($pK_a = 3.41$)

Karbonsavak előállítása

- Toluolok oxidációja

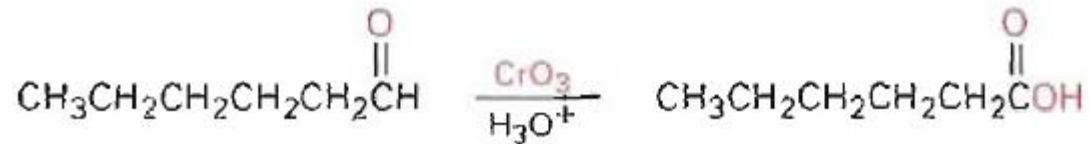
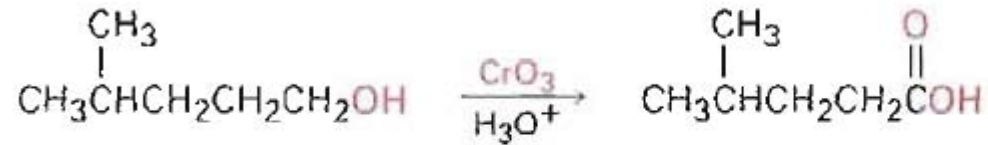


- alkének oxidatív hasítása

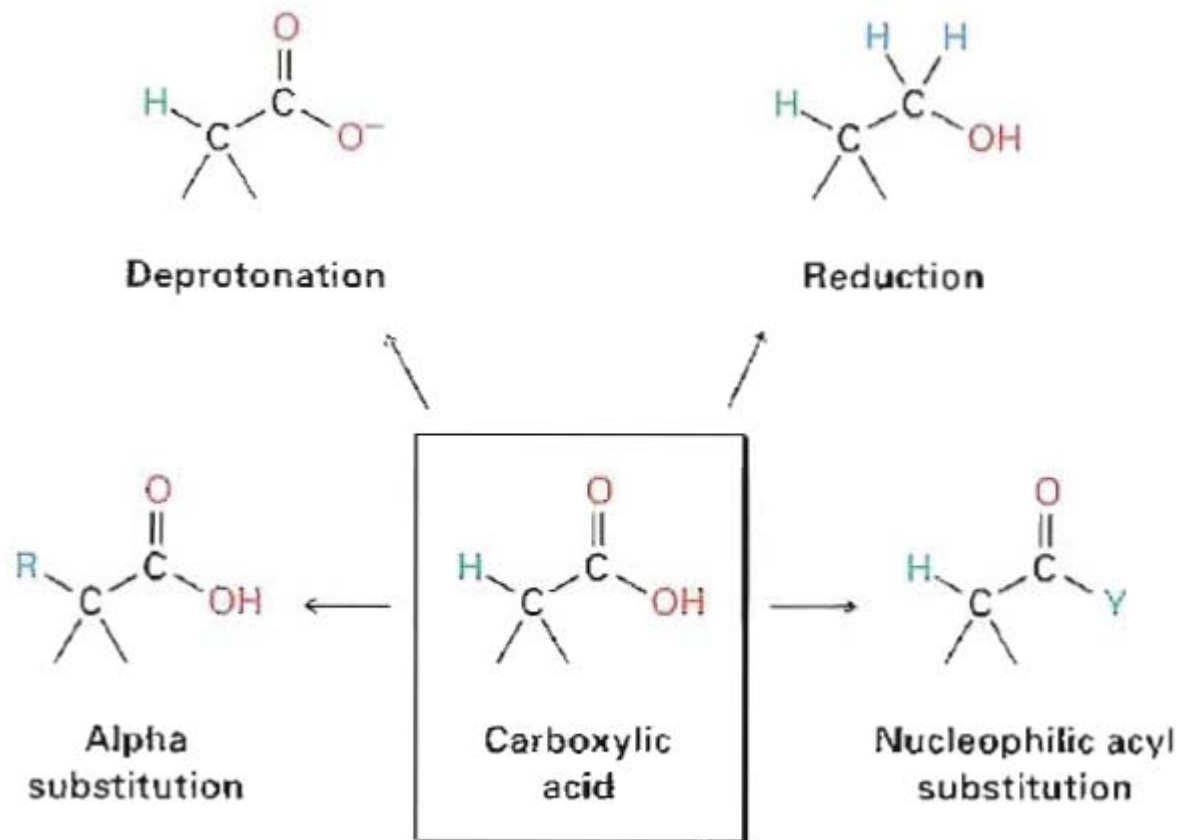


Karbonsavak előállítása

- Alkoholok vagy aldehidek oxidációja

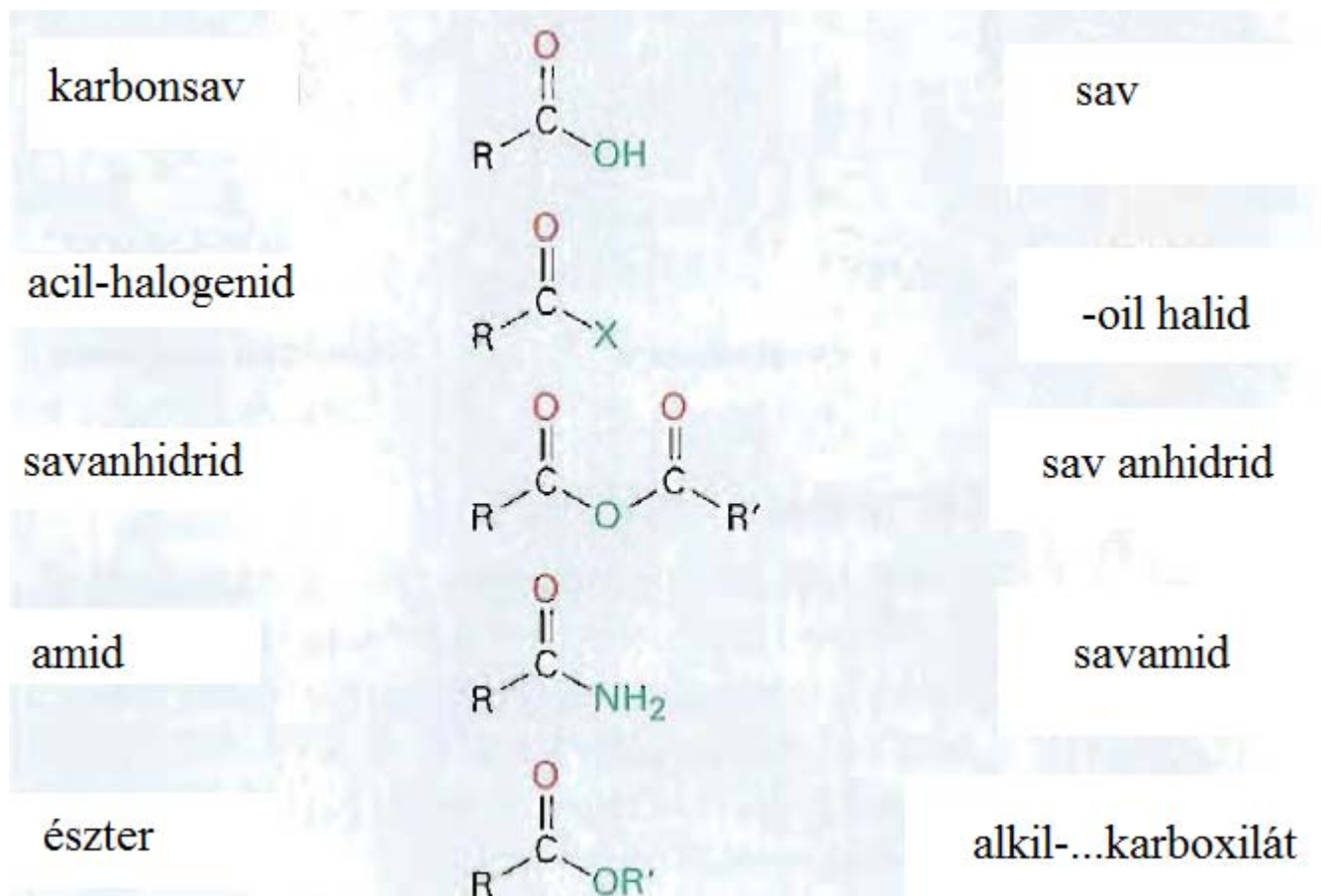


Karbonsavak reakciói

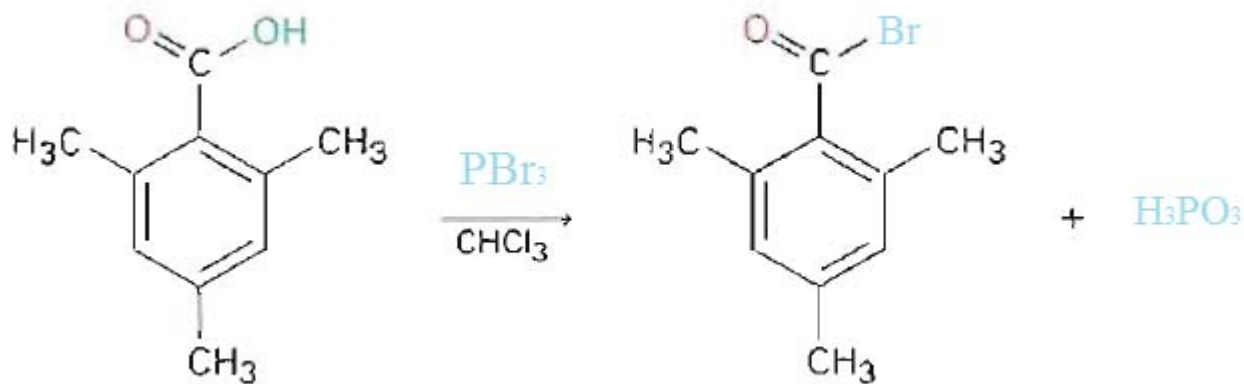
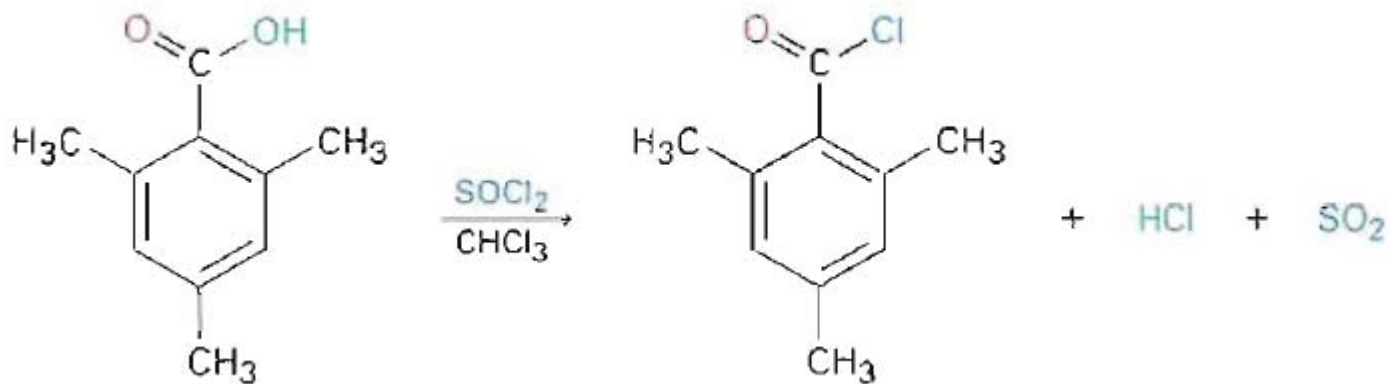


Karbonsav-származékok előállítása

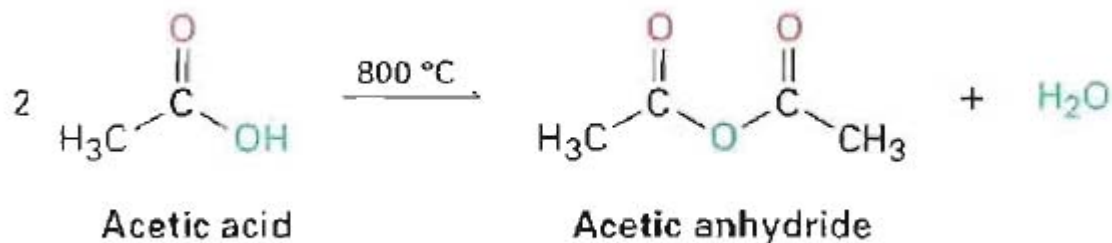
-karbonsavak nukleofil szubsztitúciós reakciói-



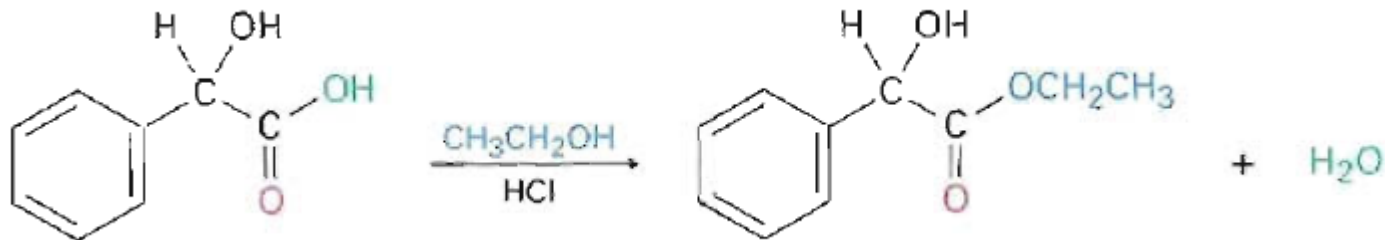
Karbonsav-halogenidek előállítása (X⁻)



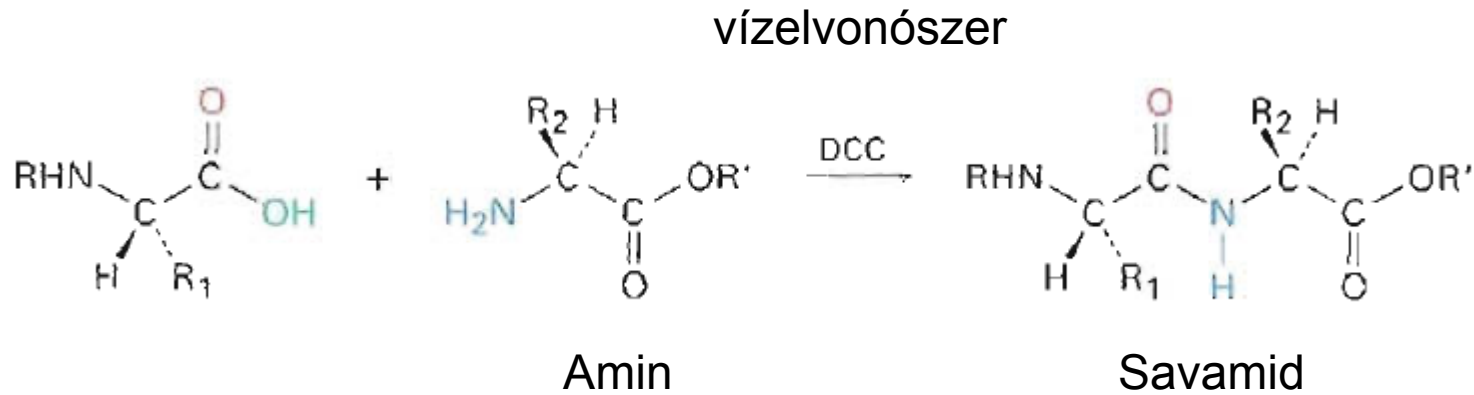
Karbonsav-anhidridek előállítása (AcO⁻)



Karbonsav-észterek előállítása (RO⁻)



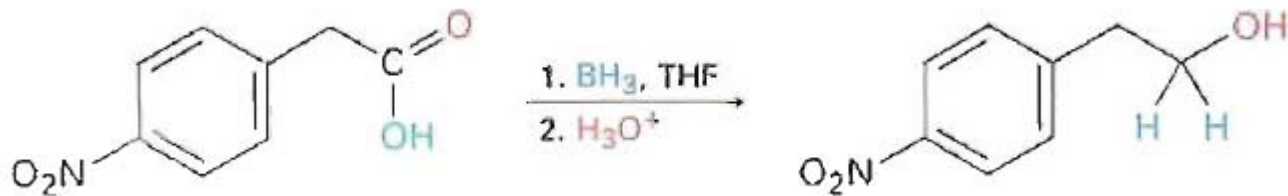
Karbonsav-amidok előállítása (RHN⁻)



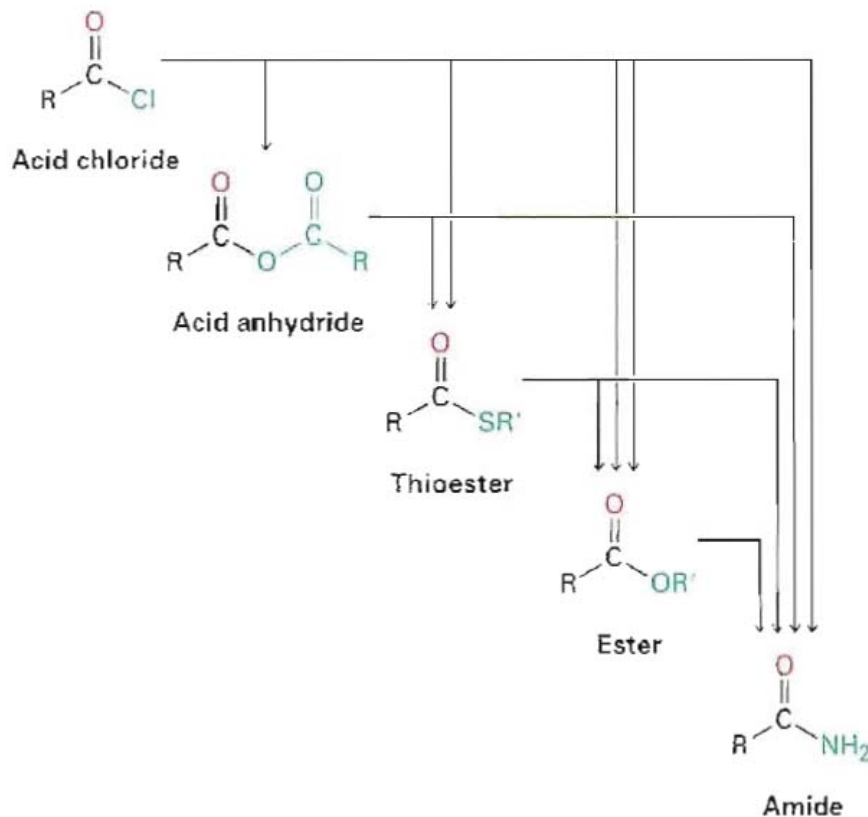
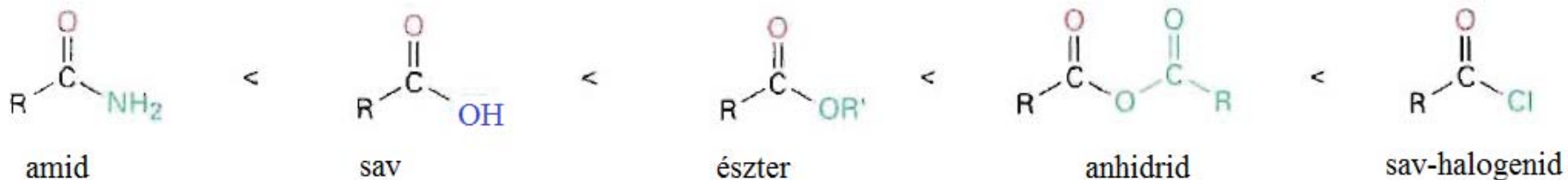
Karbonsavak redukciója



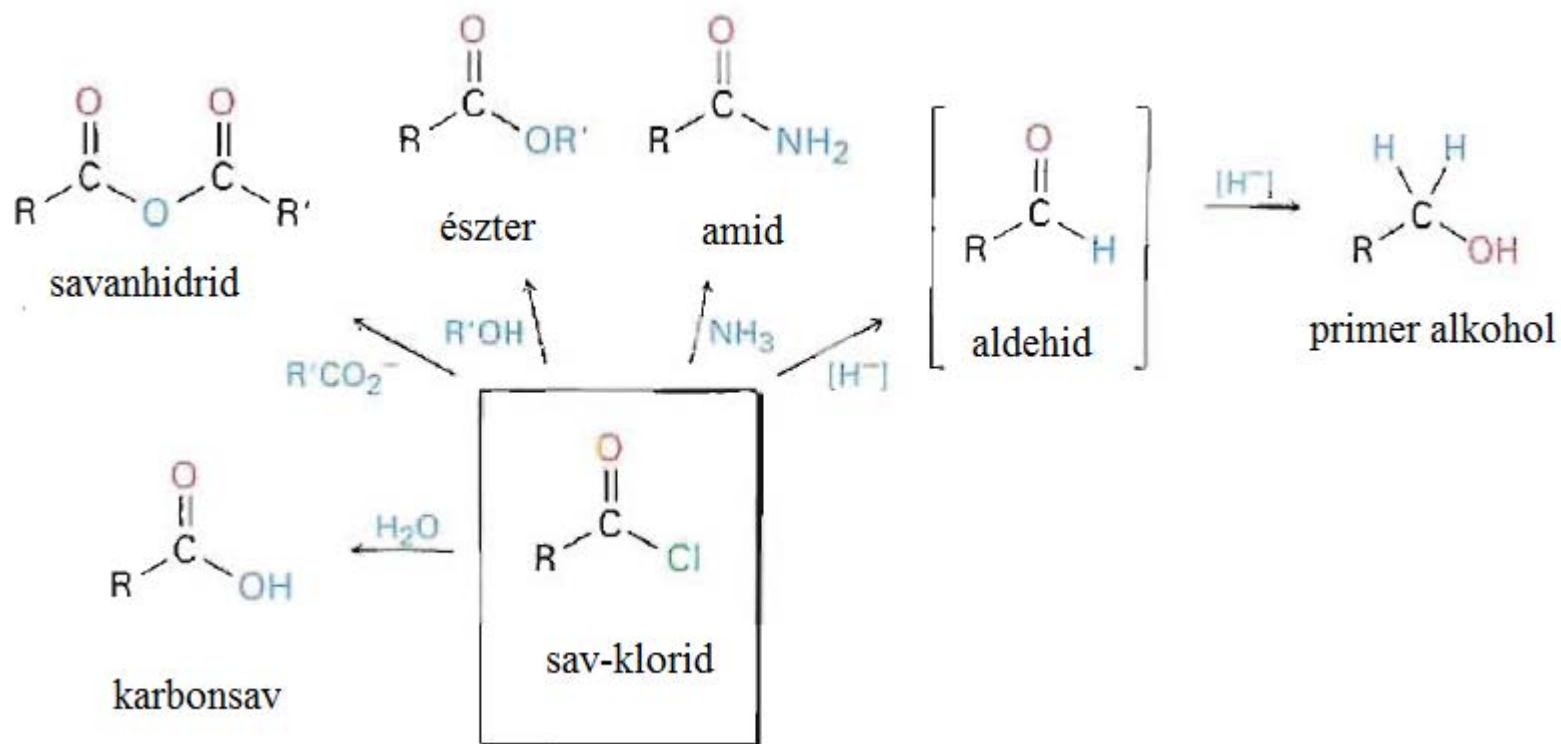
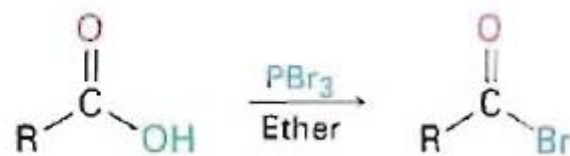
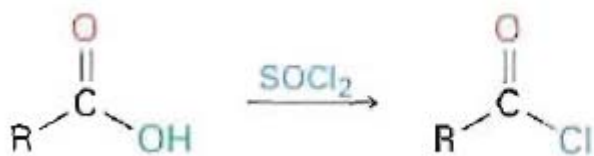
Primer alkohol



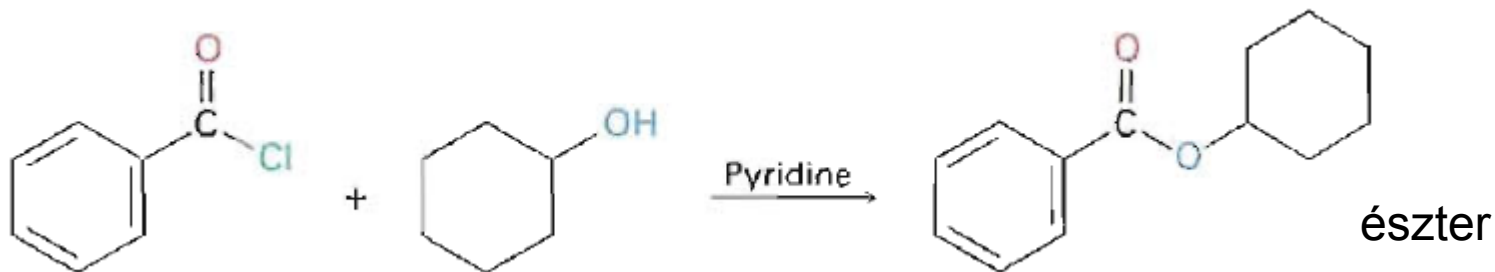
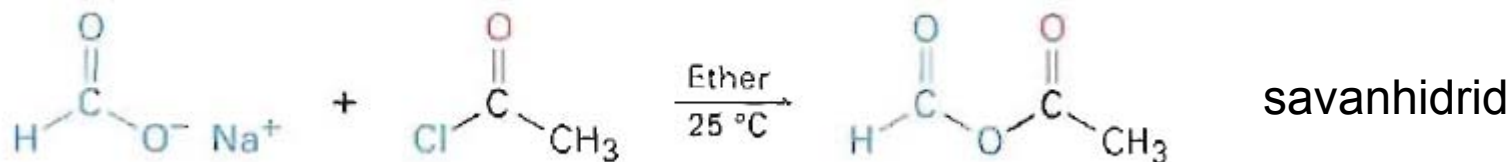
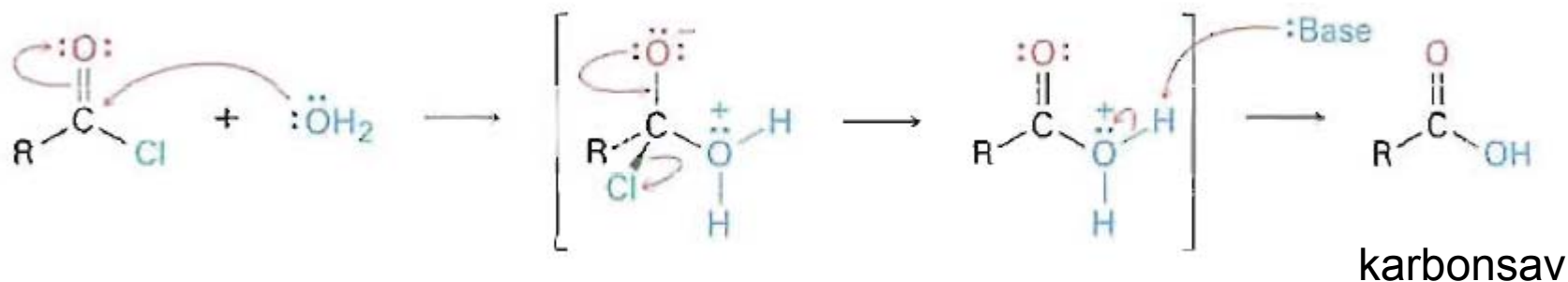
Karbonsav-származékok reakciói



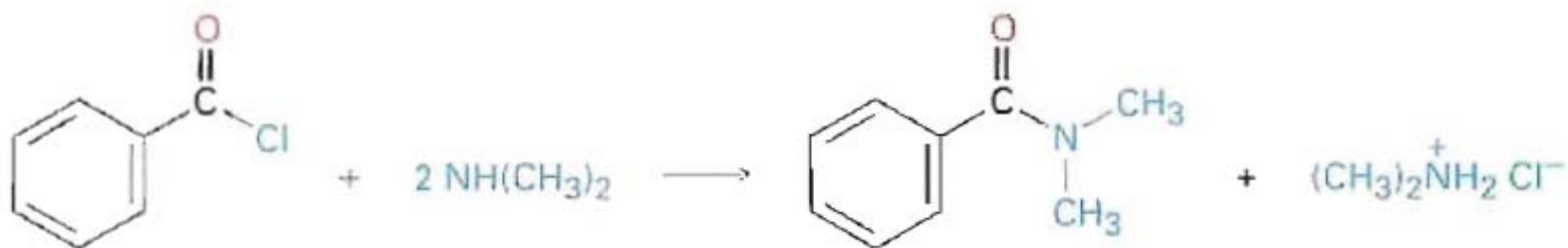
Sav-halogenidek reakciói (nukleofil szubsztitúciós reakciók)



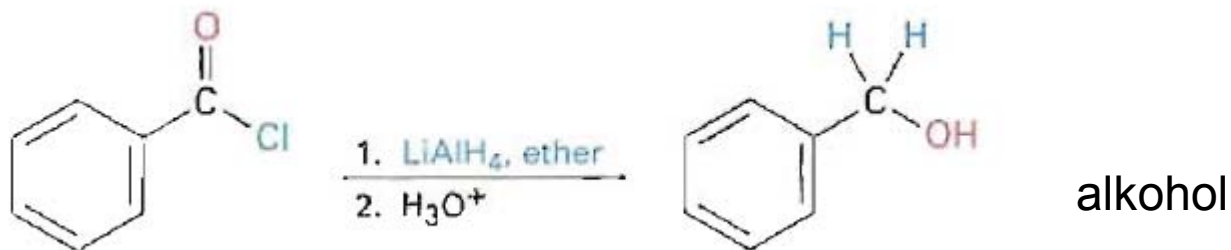
Sav-halogenidek reakciói (nukleofil szubsztitúciós reakciók)



Sav-halogenidek reakciói (nukleofil szubsztitúciós reakciók)

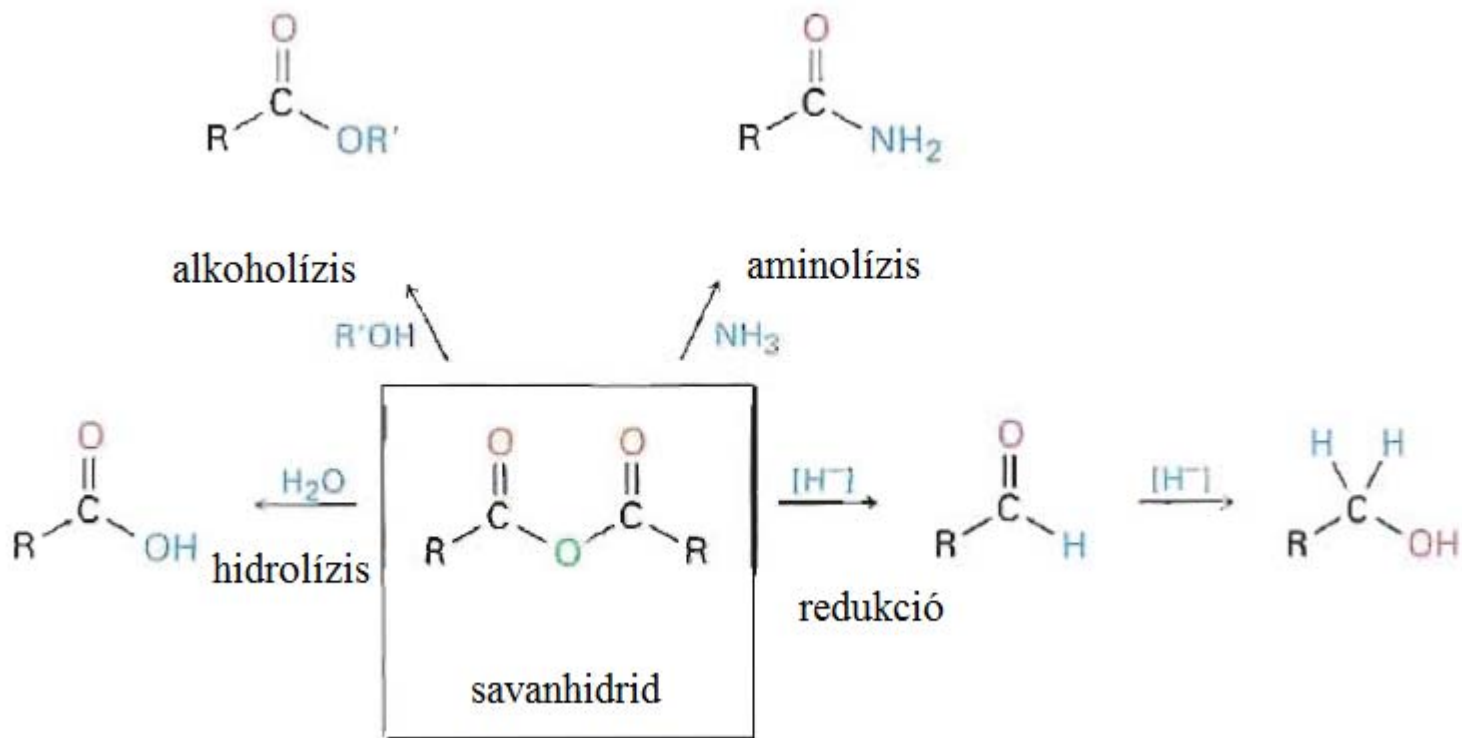


karbonsavamid

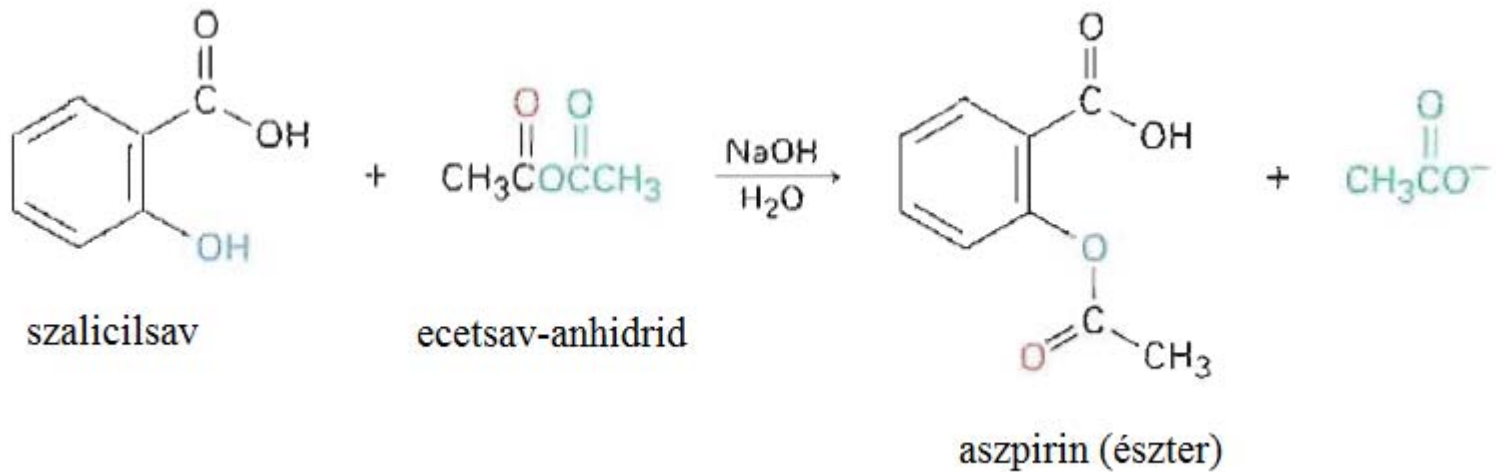


alkohol

Savanhidridek reakciói (nukleofil szubsztitúciós reakciók)

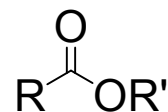
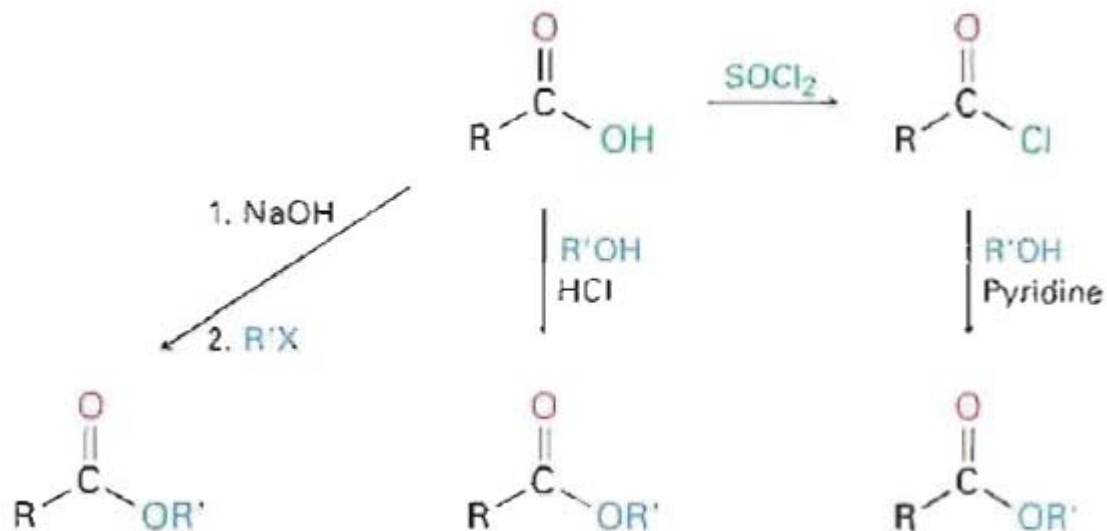


Savanhidridek reakciói (nukleofil szubsztitúciós reakciók)



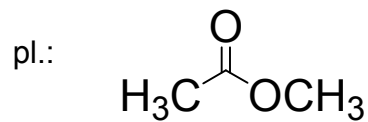
Karbonsav-észterek

előállítás



Név: R' = alkil ; $\text{RCO}-$ = karboxilát

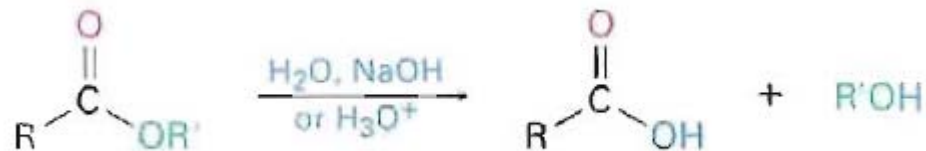
nevezéktan



metil-etanoát
(metil-acetát)

Karbonsav-észterek nukleofil szubsztitúciós reakciói

hidrolízis

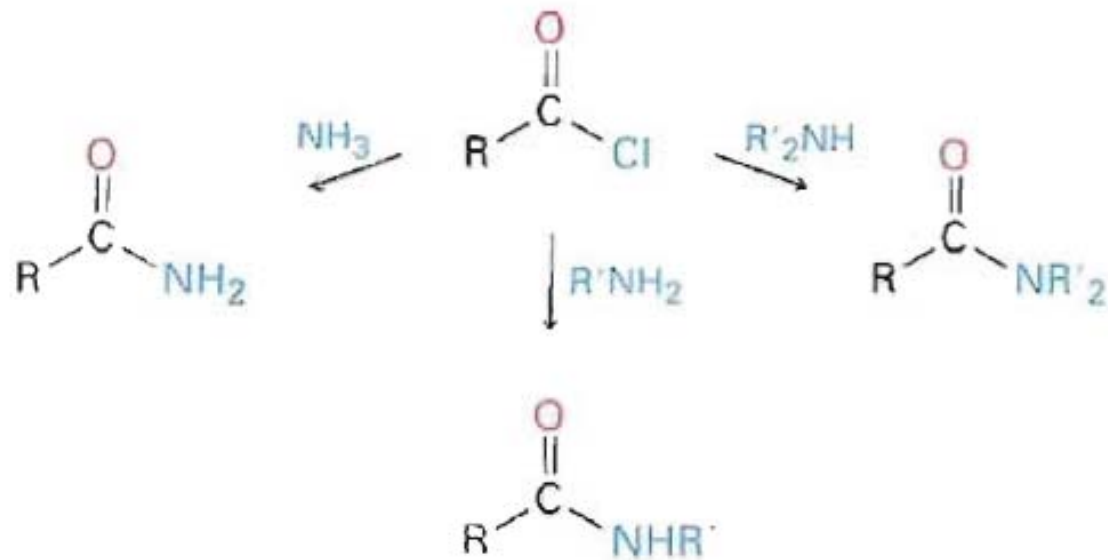


redukció



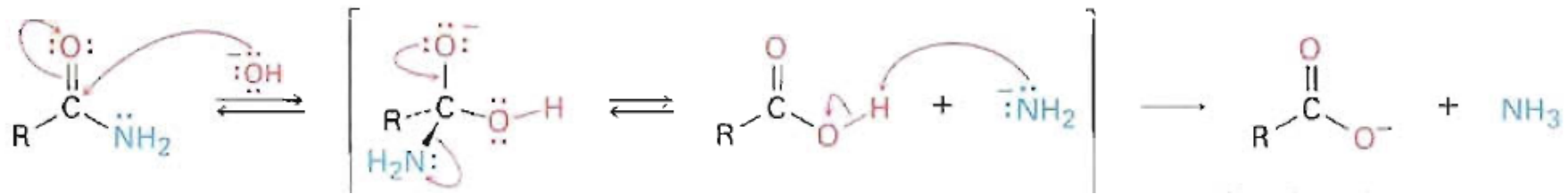
Karbonsav-amidok

előállítás

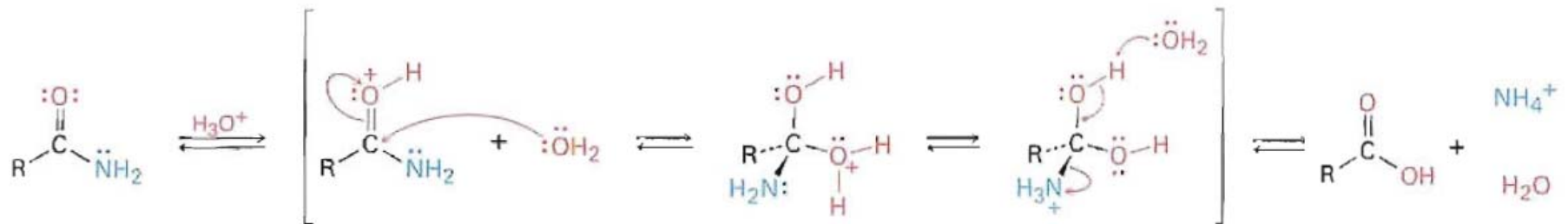


Karbonsav-amidok nukleofil szubsztitúciós reakciói

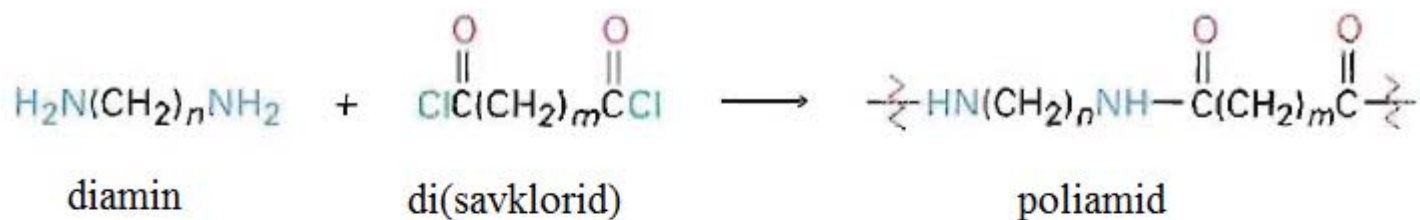
Lúgos hidrolízis



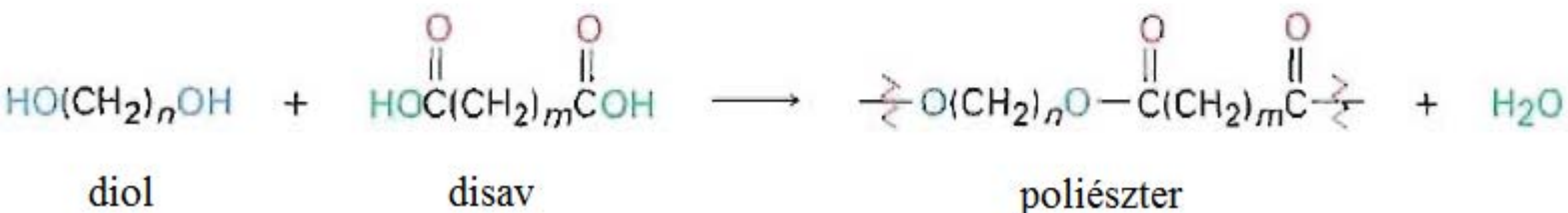
Savas hidrolízis



Karbonsav-származékok előfordulása, alkalmazása

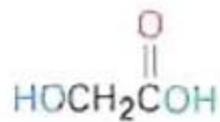


Műszálak, ruhák

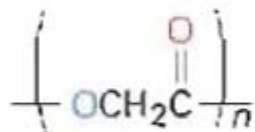


Karbonsav-származékok előfordulása, alkalmazása

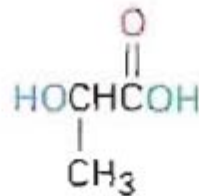
Biológiailag lebomló polimerek



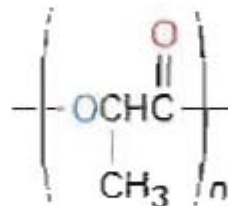
glikolsav



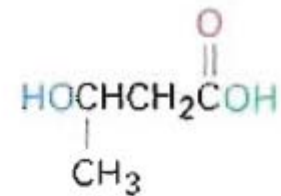
poli(glikolsav)



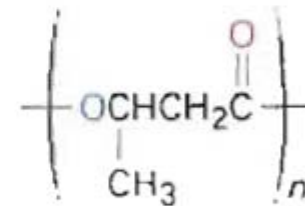
tejsav



poli(tejsav)



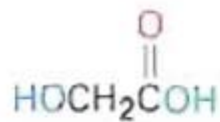
3-hidroxiavajsav



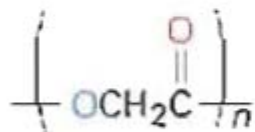
poli(hidroxiavajsav)

Karbonsav-származékok előfordulása, alkalmazása

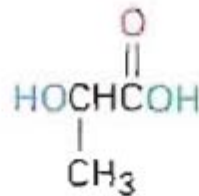
Biológiailag lebomló polimerek



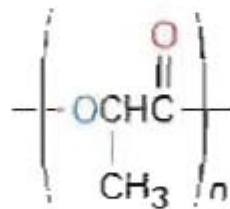
glikolsav



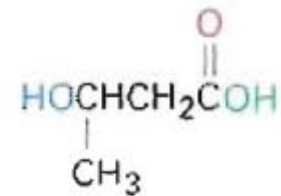
poli(glikolsav)



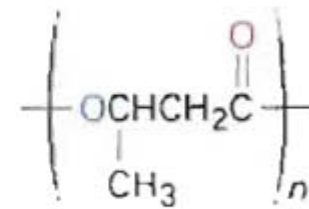
tejsav



poli(tejsav)



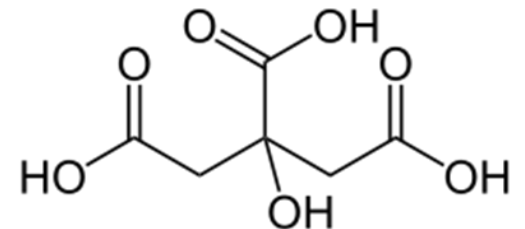
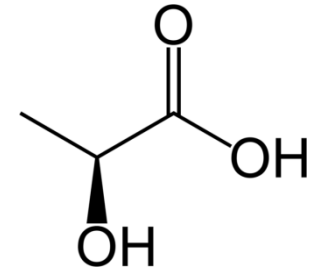
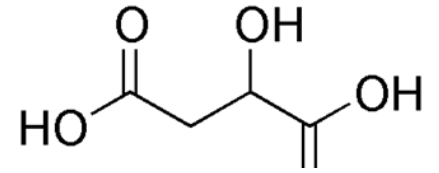
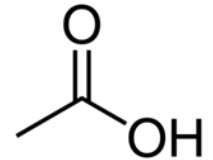
3-hidroxiavajsav



poli(hidroxiavajsav)

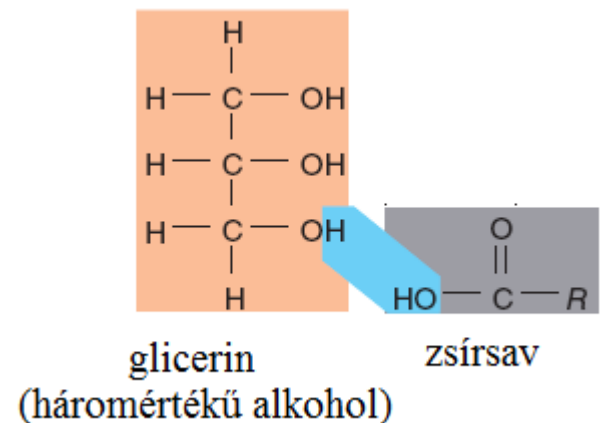
Természetes karbonsavak, karbonsav-származékok

- Ecetsav, almasav, tejsav – erjedés
- Anyagcsere termékek (citromsav, vajsav)
- Anyagcsere intermedierek (Acetil-KoA)



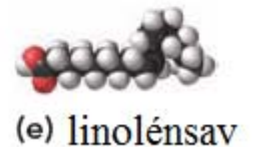
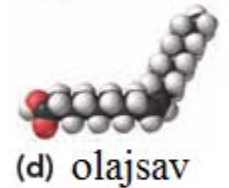
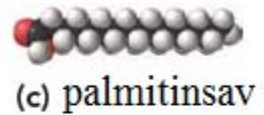
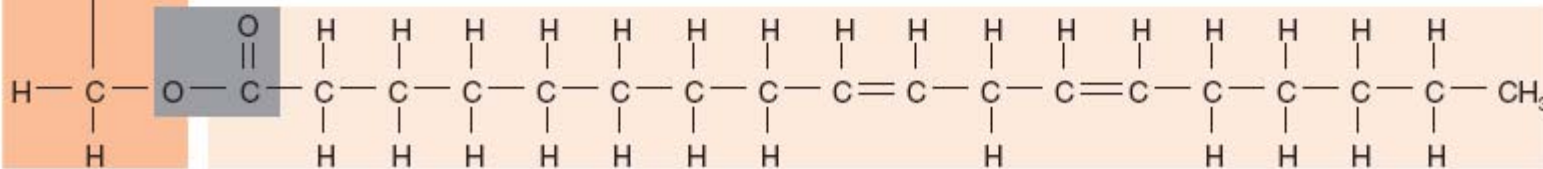
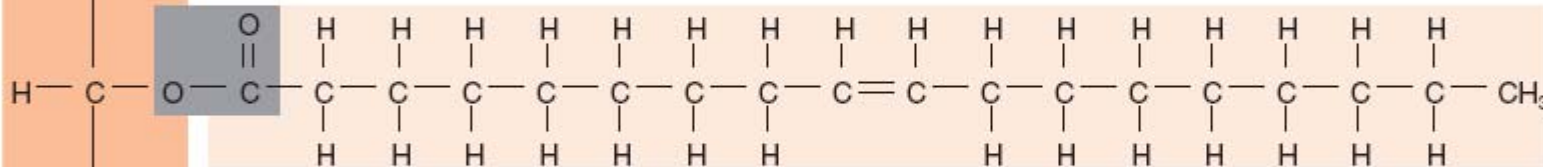
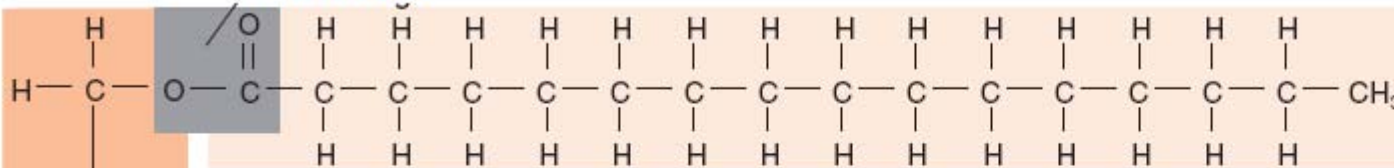
Természetes karbonsavak, karbonsav-származékok

- zsírsavak (hosszúszénláncú $-C_{16-18}$ -karbonsavak)
- telített zsírsavak (sztearinsav, palmitinsav) – pl. szappanokban ezek Na-sói
- telítetlen zsírsavak (olajsav)
- A zsírsavak glicerín (háromértékű alkohol) észterei a lipidek (= zsírok, olajok)



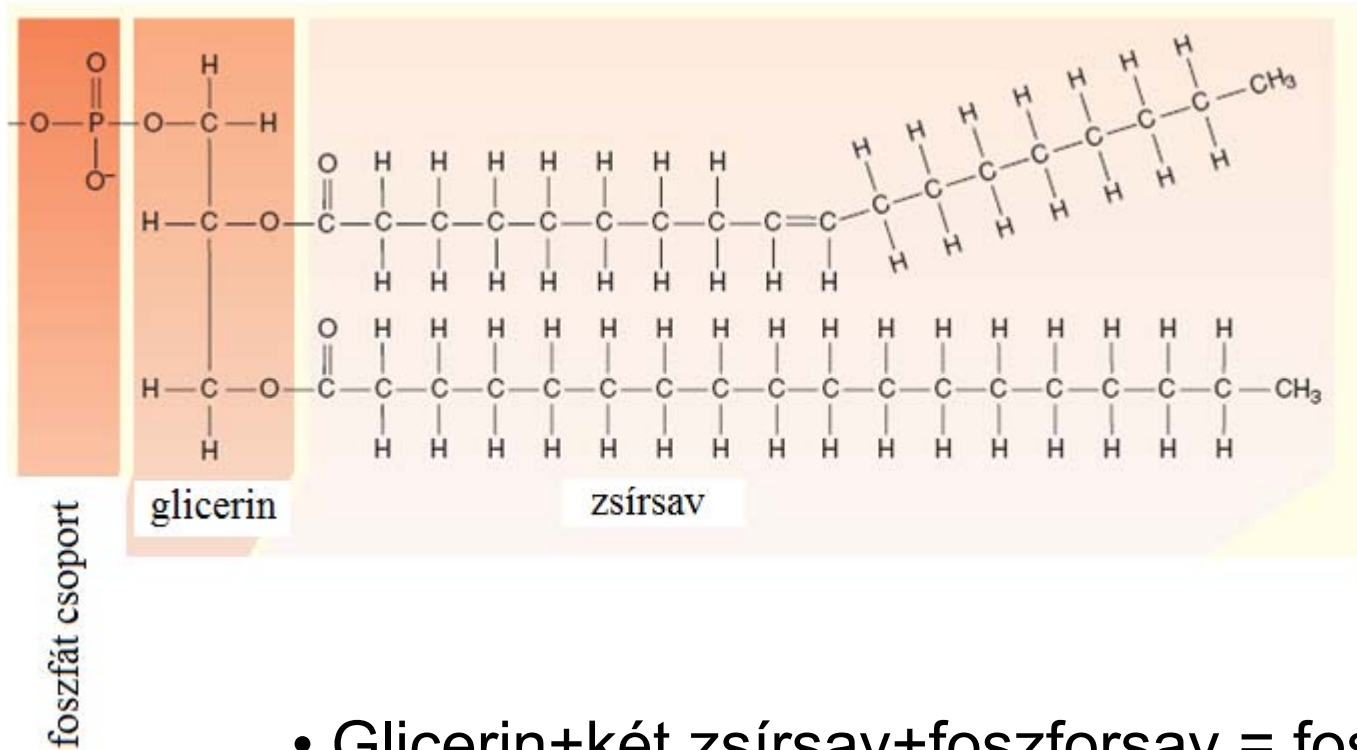
Természetes karbonsavak, karbonsav-származékok - Zsírok

észterkötés



- minél több telített zsír, annál magasabb op. (olajok vs. zsírok)
- hidrogénezéssel növényi olajokból margarin

Természetes karbonsavak, karbonsavszármazékok - foszfátészterek



- Glicerin+két zsírsav+foszforsav = foszfatidok
- Amfipatikusak (apoláris farok, poláris fej)
- Biológia membránok felépítése

Természetes karbonsavak, karbonsavszármazékok - foszfátészterek

- egyéb foszfátészterek:
- Cukor-foszfátok – DNS
- Nukleotid foszfátok (energiahordozó molekulák (ATP, ADP, AMP))

Egyéb szervetlen sav észterek – nitrát és szulfátészterek

- Glicerín trinitrát (trinitro-glicerín, nitroglicerín) – robbanóanyag (dinamit, szívgyógyszer)
- Szulfátészterek – hosszú C-láncú zsírsavak SO_4 -észterei

- A szulfátészterek Na-sói mósószerekben
- Semleges kémhatásúak (vö.: szappanokkal) nem teszik tönkre a textilt

