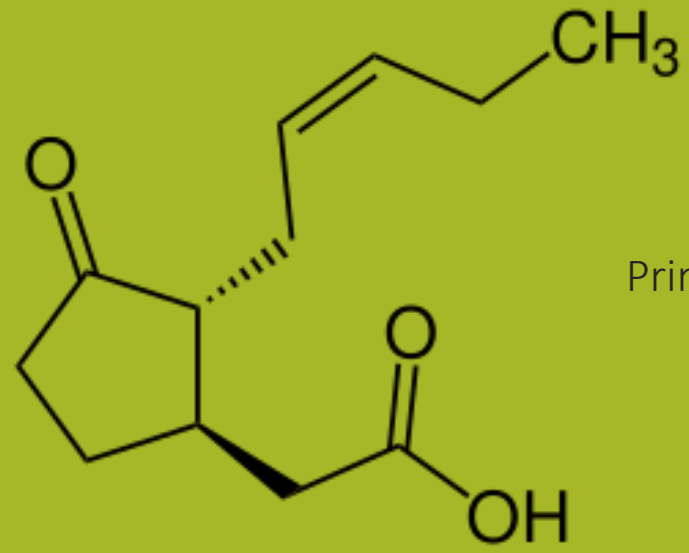




Jasmonska i salicilna kiselina – biosinteza i funkcija u biljaka



Anamarija Višnjić

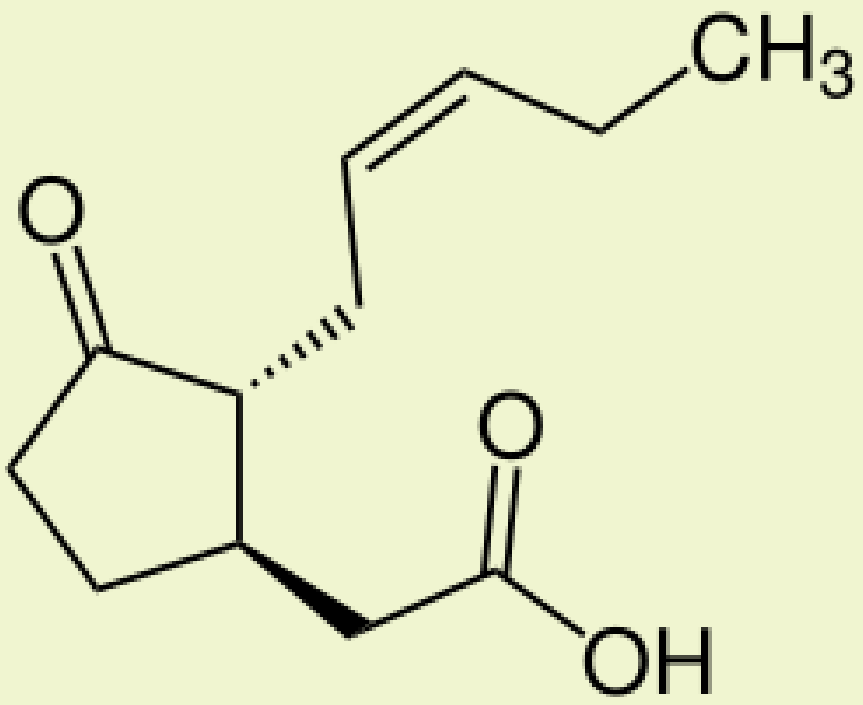
I. god. diplomskog studija Molekularna biologija

Kolegij: Molekularna biologija biljaka

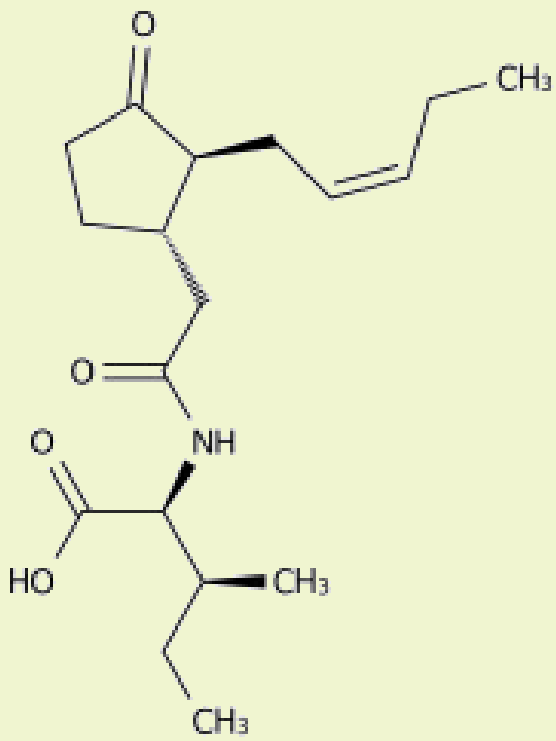
Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu

ak. god. 2026./27.

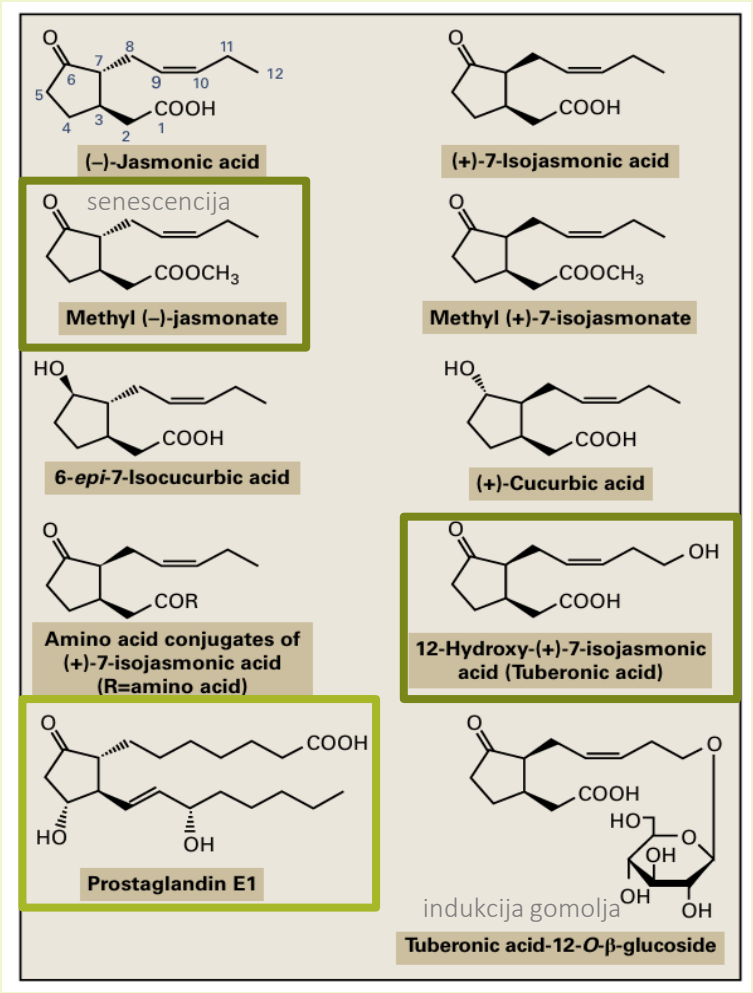




Slika 1. Jasmonska kiselina (JA)



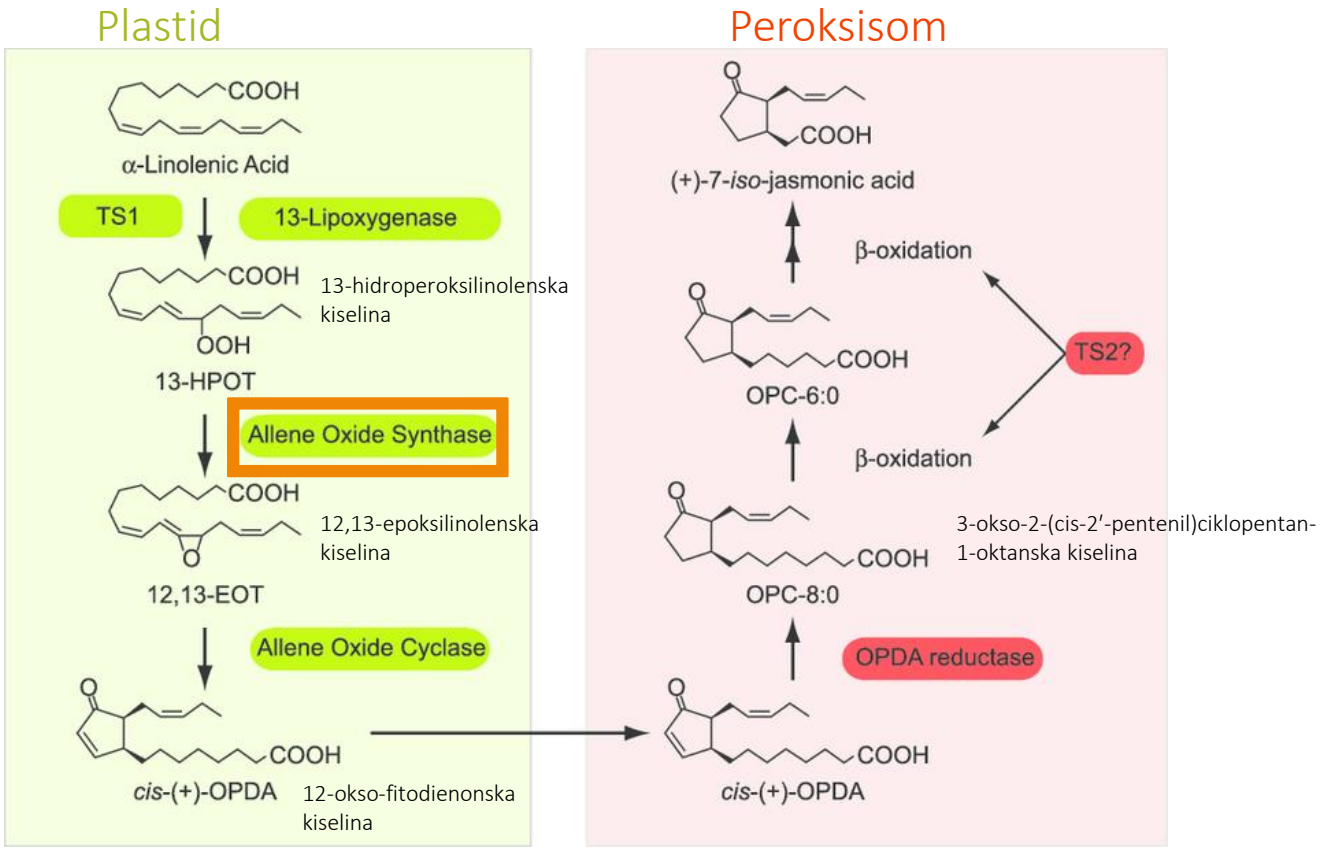
Slika 2. Jasmonil-izoleucin (JA-Ile)



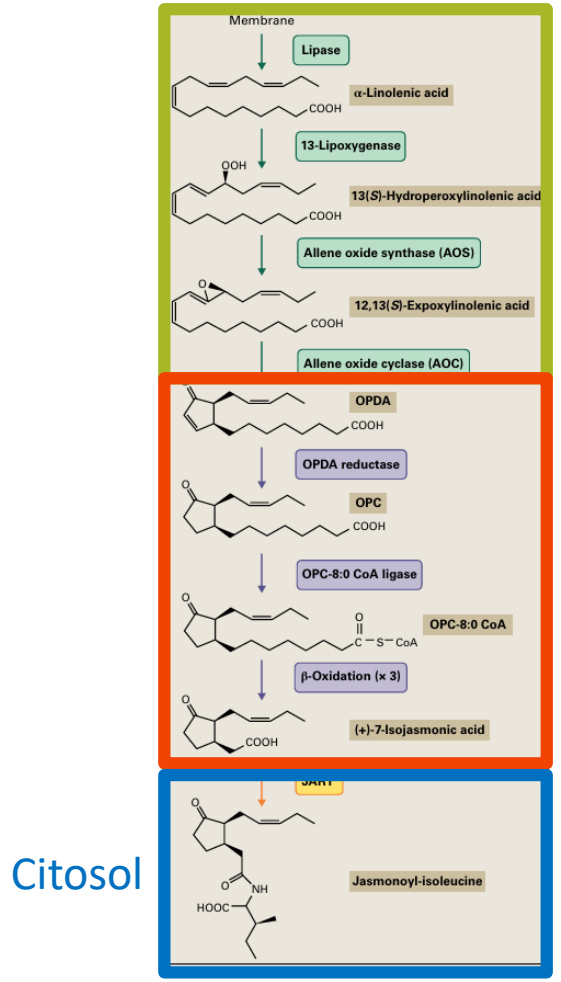
Slika 3. Jasmonati i prostaglandin

JASMONSKA KISELINA (JASMONATI)

Biosinteza



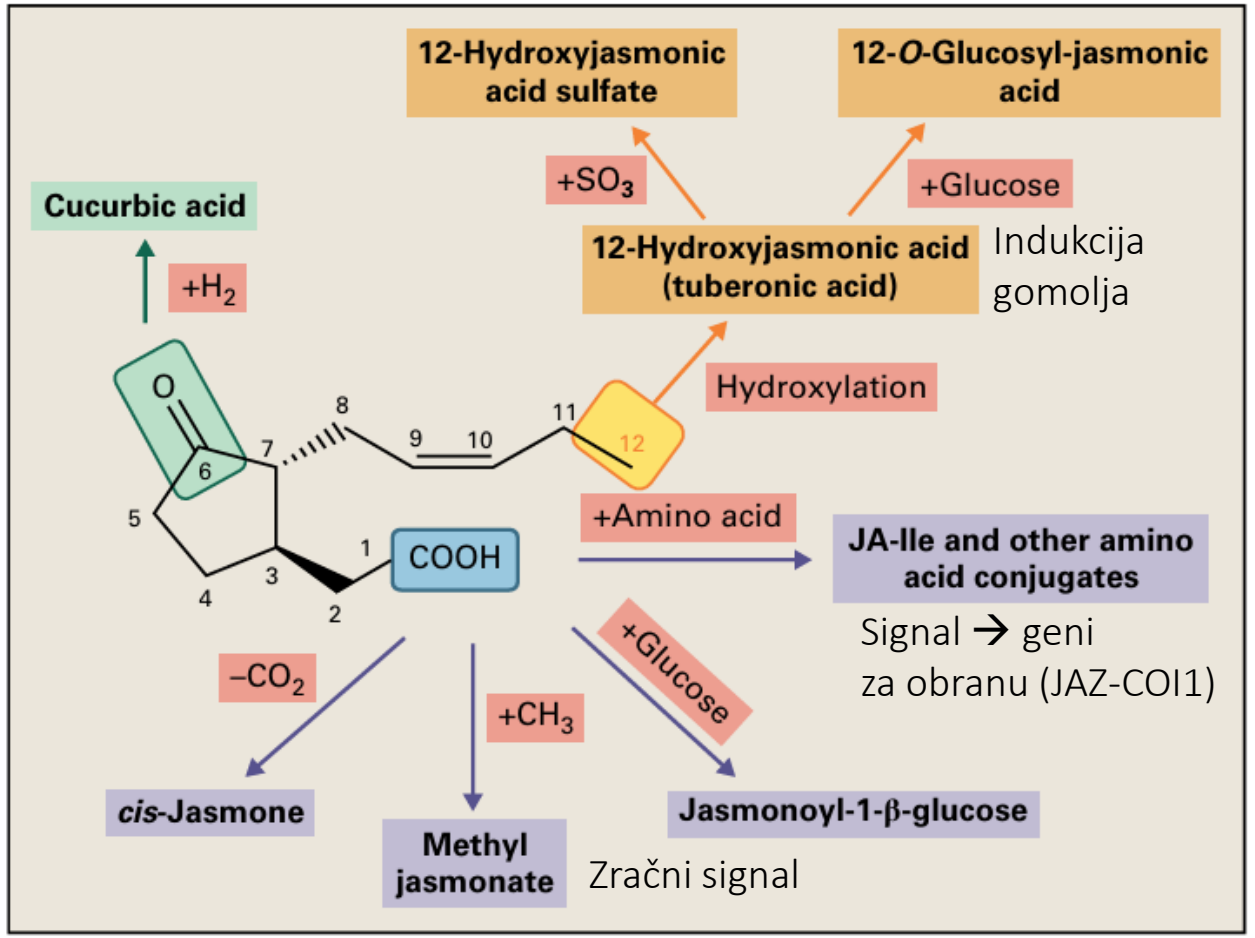
Slika 4. Shematski prikaz biosinteze JA



Slika 5. Nastavak sinteze jasmonata

Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.

Metabolizam

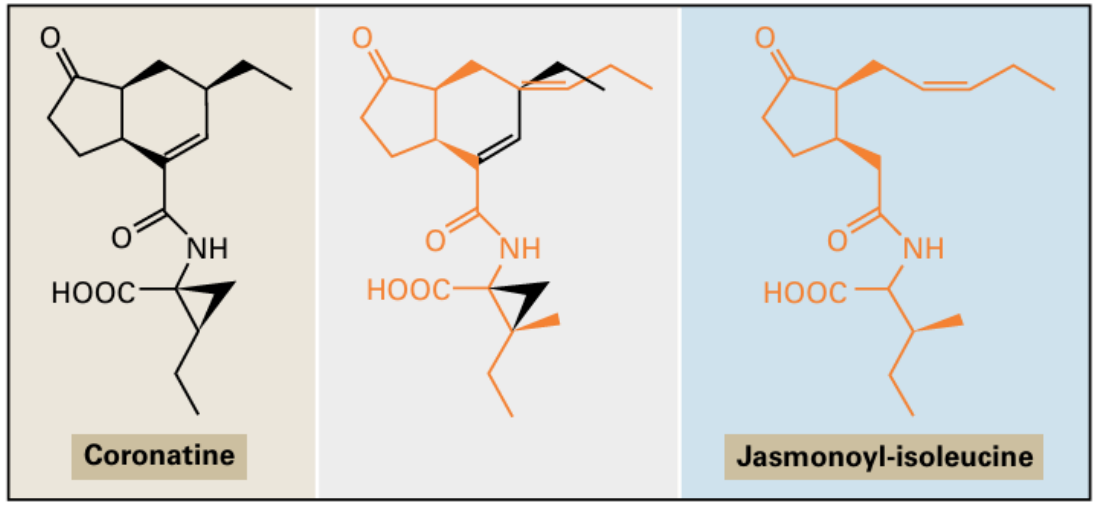


Slika 6. Metabolički putevi nakon sinteze jasmonata

Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.

Koronatin (CO)

- fitotoksin (patogene bakterije)
- aktivacija signalizacije jasmonata
- strukturna sličnost s Ja-Ile (molekularna mimikrija)
- izravno vezanje na COI-JAZ



Slika 7. Strukturna usporedba CO i JA

Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.



Uloge

1. Jasmonati inhibiraju procese rasta u mnogim biljnim tkivima
   - *egzogena JA inhibira klijanje sjemena i peluda, usporava rast korijena i potiče uvijanje vitica*
   - *sadržaj JA je visok u vegetativnim tkivima koja su ponori (sinks)*
   - *regulira nakupljanje rezervnih proteina*
2. Bitni su za reproduktivni razvoj
   - *mutanti Arabidopsis s teškim defektom u biosintezi JA ili odgovoru na JA su muški sterilni (plodnost takvih mutanata u sintezi JA može se obnoviti egzogenom primjenom JA)*
   - *ima ulogu u koordinaciji vremena rasta i razvoja cvjetnih organa (izduživanje prašnika iznad položaja njuške, pucanje prašnika u vrijeme otvaranja cvijeta, vitalnost peluda)*
3. Otpornost na patogene
   - *biljke nakupljaju JA i njegove derivate kada su ozlijeđene ili tretirane elicitorima podrijetlom od patogena (oligosaharidima)*
   - *egzogeni tretman JA aktivira ekspresiju stotina gena povezanih s obranom*
   - *egzogeni tretman JA smanjuje ekspresiju gena koji kodiraju enzime uključene u rast i primarni metabolizam*

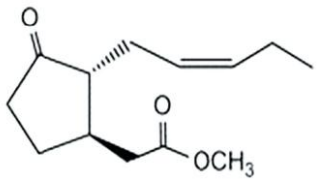
Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.

Upotreba

- industrija parfema
- odobren kao prehrambena aroma



Jasminumgrandiflorum



Methyl jasmonate

Slika 8. Metil jasmonat, izolacija iz biljke i struktura

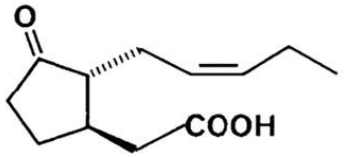
- istraživanja protuupalnog i antitumorskog djelovanja
- obnavljanje epiderme i smanjenje starenja

prva zelena biljka iz koje je slobodna jasmonska kiselina izolirana i identificirana kao inhibitor rasta (perikarp)

(A)



Broad beans (*Viciafaba*)

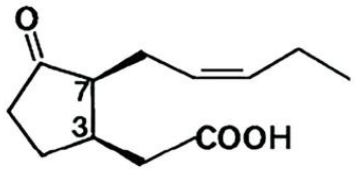


(-)-Jasmonic acid

(B)



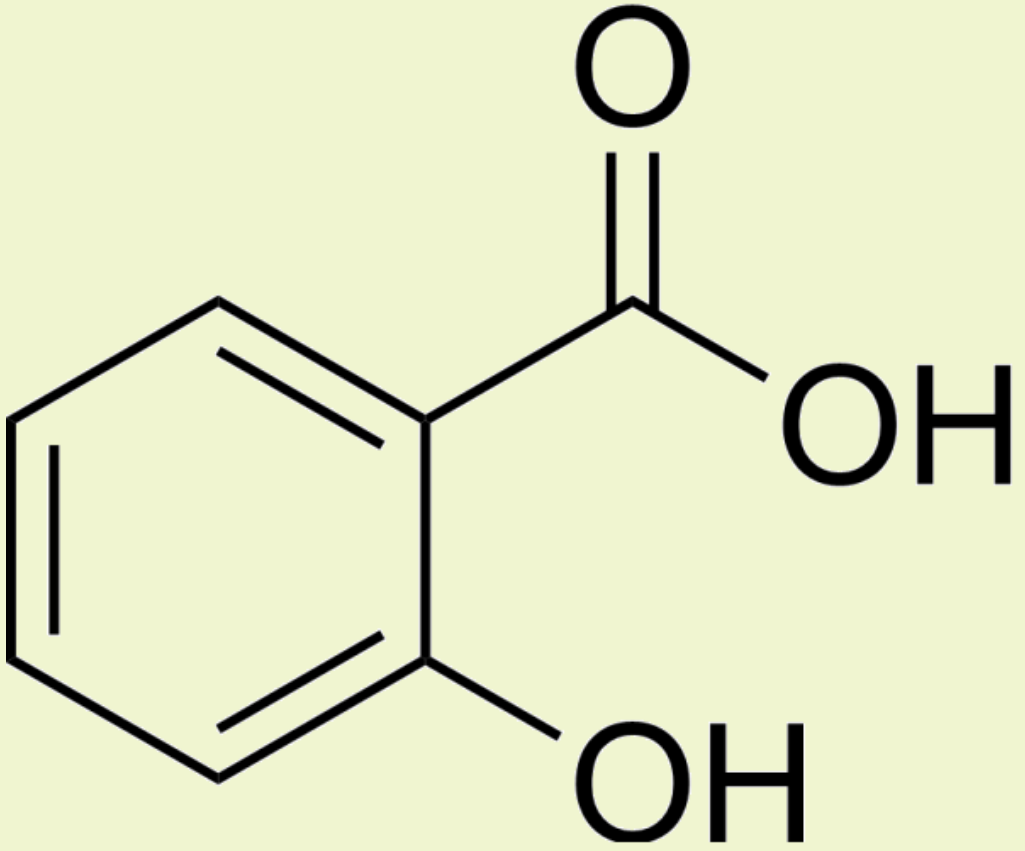
Broad beans fruits



(+)-7-iso jasmonic acid

Slika 9. (A) i (B) Stereoizomeri JA i izolacija iz biljke

Bhatla, S.C. (2018), Plant Physiology, Development and Metabolism



(A)



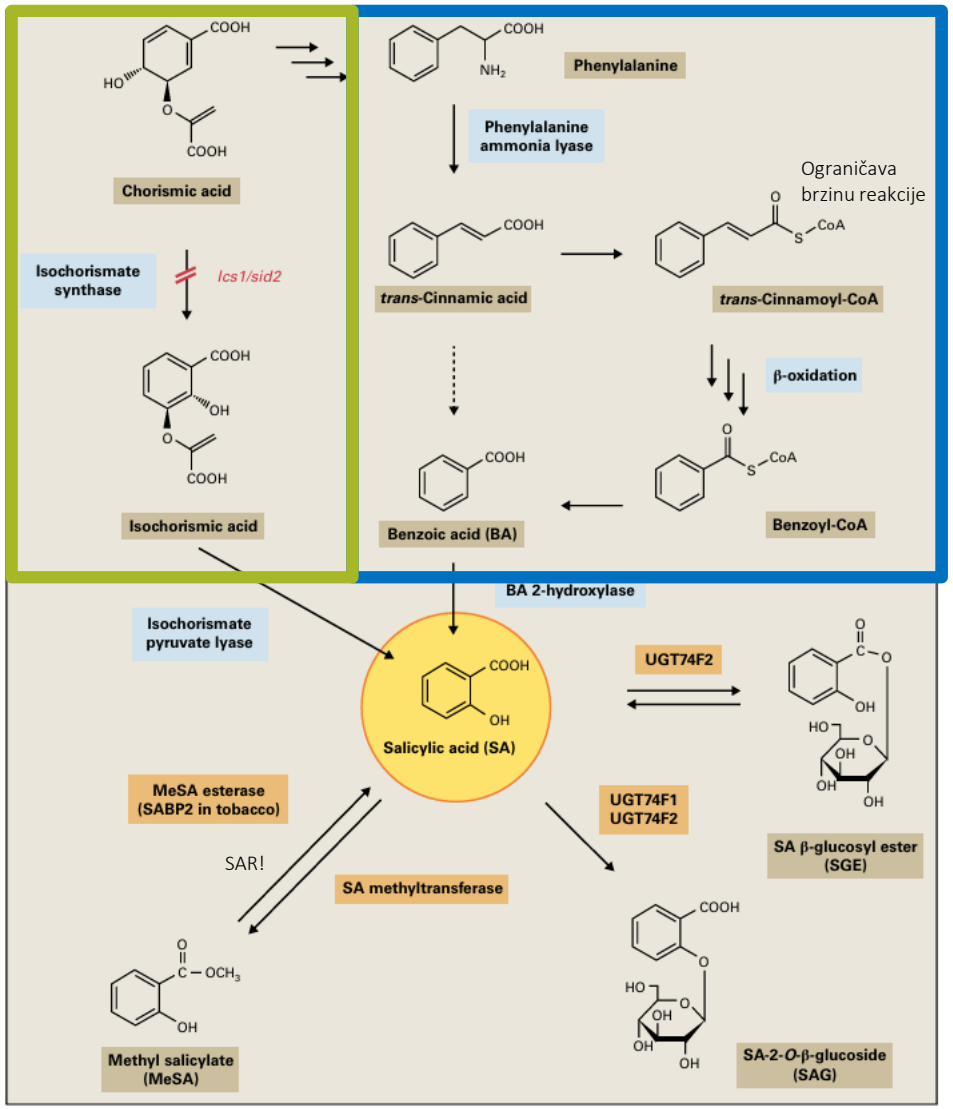
(B)

Slika 10. (A) struktura SA, (B) kozmetički pripravak SA

SALICILNA KISELINA

Biosinteza i derivati







Slika 11. Biosinteza SA i derivata

Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.

Uloge

1. Usporava starenje latica
   - ❖ *smanjena brzina biosinteze etilena (SA blokira pretvorbu ACC u etilen)*
   - ❖ *topive tablete aspirina u vodi; pretvorba acetil-SA u SA – produljenje trajanja rezanog cvijeća*
2. Potiče cvatnju
   - ❖ *u vodenim lećama*
   - ❖ *uzgoj biljaka dugog dana pod uvjetima kratkog dana (nespecifično)*
3. Regulacija termogeneze
   - ❖ *Sauromatum guttatum; endogena uloga*
   - ❖ *termogeneza i protok elektrona*
   - ❖ *povećanje temperature spadiksa do 14 ℃ iznad okoline u poslijepodne*
   - ❖ *drugi val termogeničnosti kasno navečer*
   - ❖ *kalorigen (1937.) = SA*



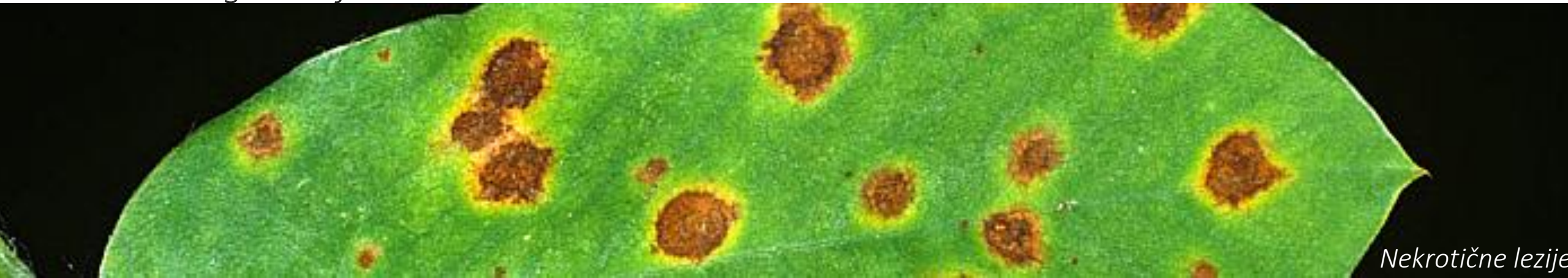
Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.

Uloge

4. Hipersenzitivni odgovor i otpornost na bolesti

- *mehanizam otpornosti na bolesti, ograničavanje širenja stvaranjem nekrotičnih lezija*
- *lokalizirana stanična smrt*
- *sistemski stečena otpornost (SAR)*
- *proteini povezani s patogenezom (PR)*
- *endogena SA ima ulogu u prijenosu signala koji dovodi do aktivacije gena koji kodiraju za PR*
- *ne na duge udaljenosti!*

Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.



Nekrotične lezije


Salix alba

Upotreba


Myrtus communis

Priča o Aspirinu

- 4. st. pr. Kr. – vrba, mirta, topola; ublažavanje bolova
- 19. st. – izolacija SA (metil salicilat, saligenin i glukozidi istih) iz vrbe

  - kemijska sinteza salicilne kiseline u Njemačkoj, komercijalna proizvodnja

  - unaprjeđenje F. Bayer – acetilirani derivat, acetilsalicilna kiselina = ASPIRIN
- prehlada, glavobolja, groznica, reumatoidni artritis
- prevencija liječenja srčanih udara i cerebralne tromboze (usporavanje proizvodnje prostaglandina – potiču zgrušavanje krvi)
- Reyeov sindrom (oticanje mozga i zatajenje jetre); oštećenje mt (ciklus uree, β-oksidacije mk, virusna infekcija)



Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.









Slika 12. Akne i često korišteni tretmani

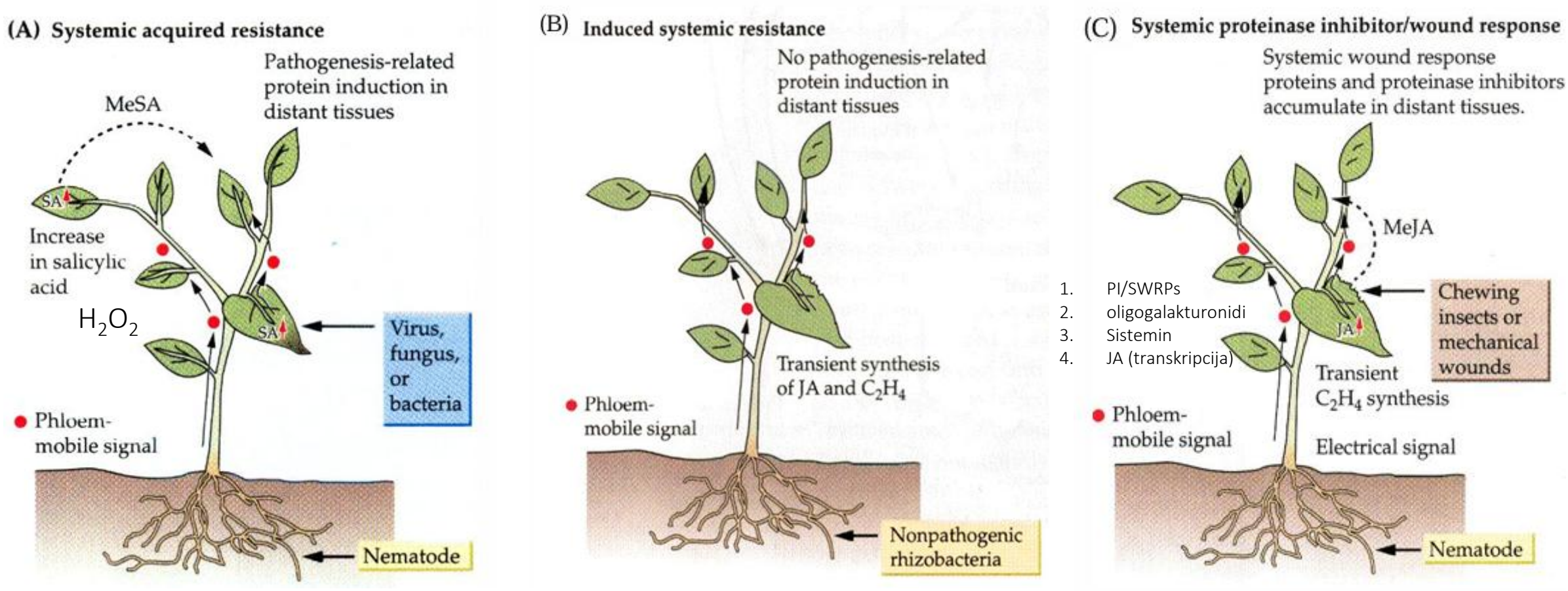
Upotreba

Salicilna kiselina i kozmetika

- Acne vulgaris (AV); prekomjerna proizvodnja sebuma, folikularna hiperkeratinizacija, mikrobna kolonizacija i upala
- SA ima sposobnost prodiranja u folikule ispunjene sebumom, otapljanje keratiniziranih naslaga i smanjenje komedogne aktivnosti
  → izvlačenje dezomosoma, inhibicija signalnog puta u proizvodnji lipida i upalnog signalnog puta
- ima i blaga protuupalna svojstva, regulira proizvodnju ulja
- suhoća ili iritacija – kombinacija s gelom

Liu Y et al., Clinical Efficacy of a Salicylic Acid-Containing Gel on Acne Management and Skin Barrier Function (2025)

„Imunosni sustav" biljaka



1. PI/SWRPs
2. oligogalakturonidi
3. Sistemin
4. JA (transkripcija)

indukcija PR proteina u udaljenim biljnim tkivima

nema indukcije PR proteina u udaljenim biljnim tkivima

Slika 13. (A) SAR, (B) ISR, (C) SWRPs and PIs

Buchanan, B., Gruissem, W., Jones, R. L. (2002), Biochemistry and Molecular Biology of Plants

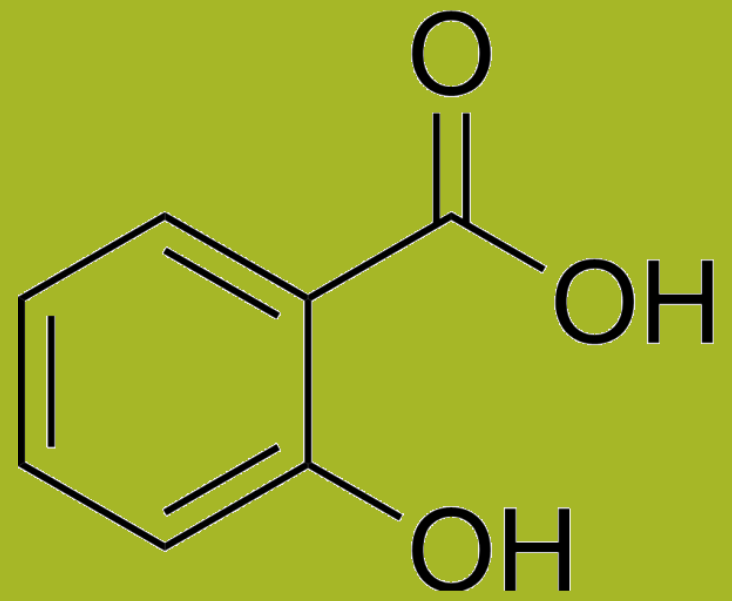
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- Liu Y, et. al. (2025). Clinical Efficacy of a Salicylic Acid-Containing Gel on Acne Management and Skin Barrier Function: A 21-Day Prospective Study.
- Buchanan, B., Gruissem, W., Jones, R. L. (2002). Biochemistry and Molecular Biology of Plants
- Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.

Izvori slika

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- https://products.dm-static.com/images/f_auto,q_auto,c_fit,h_1200,w_1200/v1747500319/assets/pas/images/bcd72b0f-84ed-41c4-b2e1-ab1d46398e31/the-solution-losion-sa-salicilnom-kiselinom
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Hvala na pažnji

Pitanja?

