

Future Innovations in the Cannabis Industry

Dr. Jason Poulos, Ph.D

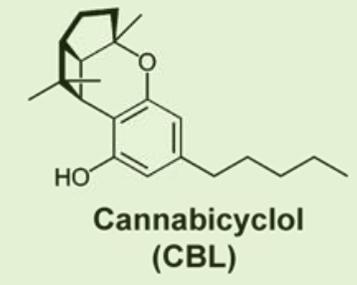
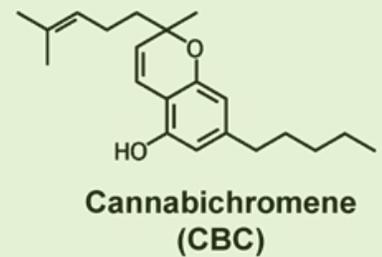
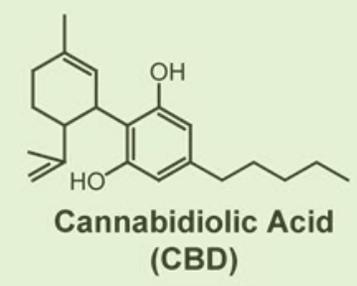
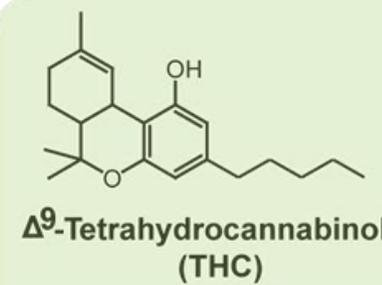
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Why do we grow cannabis?



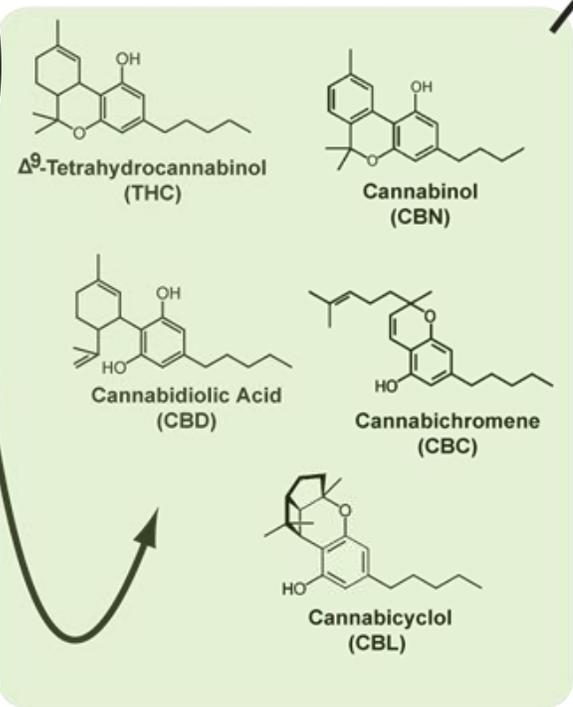
Cannabinoids



Endocannabinoid System



Cannabinoids



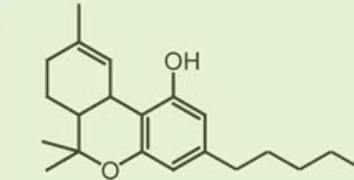
Why do we grow cannabis?



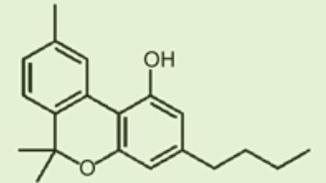
The cannabis plant is a production factory for cannabinoids



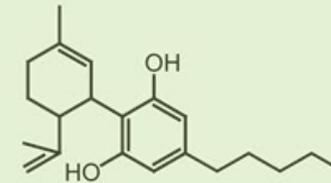
Cannabinoids



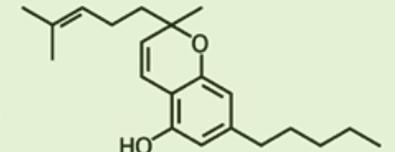
Δ^9 -Tetrahydrocannabinol (THC)



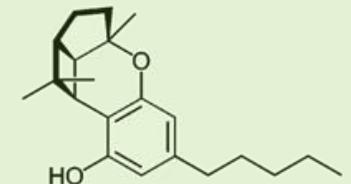
Cannabinol (CBN)



Cannabidiolic Acid (CBD)



Cannabichromene (CBC)



Cannabicyclol (CBL)



Not a Cannabis Industry, A Cannabinoid Industry

Cannabinoids are an agricultural commodity



A Commodity Market

- High volume and low cost
- Technology has a role



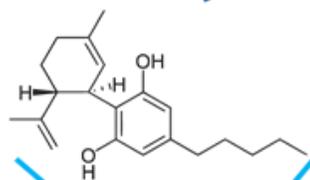
Aspirin from the Willow Tree

Cannabis produces Marinol

This has been done before:
Cannabinoids are natural products

Natural Product Development

Stage:
Discovery (ug)



Source:
Natural

 $>10^9$ increase
in production

Production (kg)



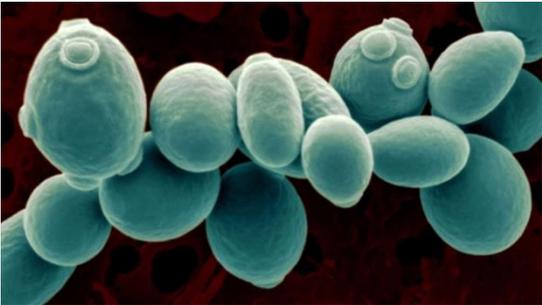
Biosynthetic/Synthetic

Agricultural Production at Industrial Scale

- Not environmentally or economically sustainable
 - Land use
 - Water use
 - Fertilizers/pesticides
 - High energy
 - Supply volatility



Alternative Cannabinoid Production

Production Technology	Status	Limitations	
Synthetic Chemistry	Proven for major cannabinoids at large scale	High Cost	   
Biosynthetic Technology	Proven for major cannabinoids at small scale	High Cost Scale	  

The Future of Cannabinoid Production



Economic Outlook

- Small business fuel economic engines
- Biopharama Jobs*
 - 1 biopharma job = 5 total jobs
 - \$31.8B output in San Diego
- Salary \$123k* (\$170k locally)
 - Agricultural salary = \$25k**



Preparing for Change

- Regulations
 - Community Impact



Regulations

- Regulations create opportunity
 - Regulate in a way that benefits long term goals
 - Well defined regulations help businesses grow
- Production method is not important
 - Not about plants, about compounds (cannabinoids)
 - Not about 'seed-to-sale' or sqft
- We can learn from others
 - ISO



International
Organization for
Standardization

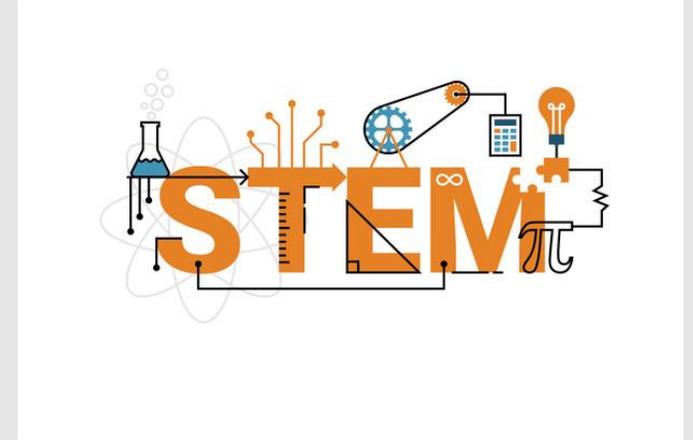


Community Impact

- What is important to the community in the next 10 years?
 - Save resources
 - Water
 - Energy
 - 2% of Denver's electricity is for cannabis
 - Minimize pollution
 - Let innovation happen to meet your goals

This area is well positioned

- Here now
 - 7,000 STEM graduates locally
 - >11M sqft of lab space
 - A venture capital community
- What could happen
 - Local support of incubators
 - City could support early stage biotech
 - Funds/space
 - Clear regulations to support investment



Expect Changes

- Large markets will attract innovation
- Technology can be used to meet economic and environmental sustainability goals
- Plan for tomorrow

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Thank You!

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