

THE EMERALD CONFERENCE

Produced by MJBizScience

Solving Cannabis Consistency and Bioavailability Problems through Nanoemulsion Technology



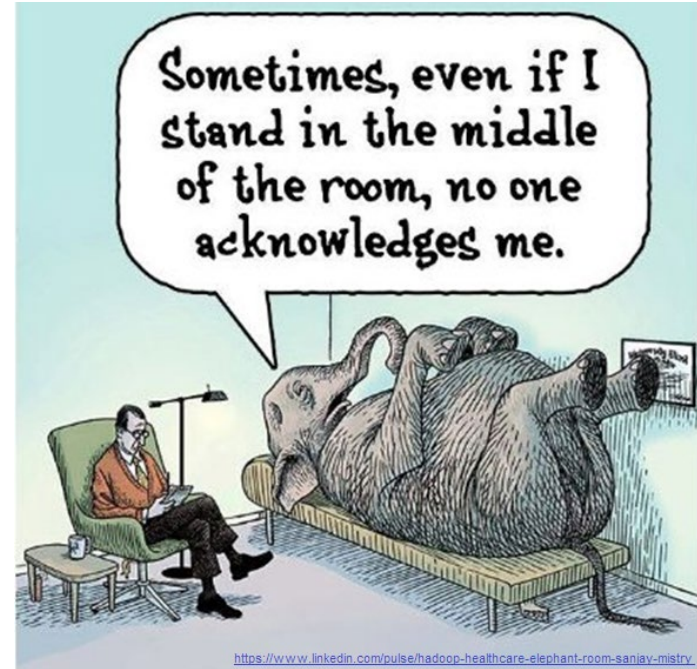
David Durkee
Vice President, New Ventures
Quicksilver Scientific

Key Themes

1. The science of small.
1. How the science of small can deliver superior products in a burgeoning edible marketplace.

Why Nanoemulsion?

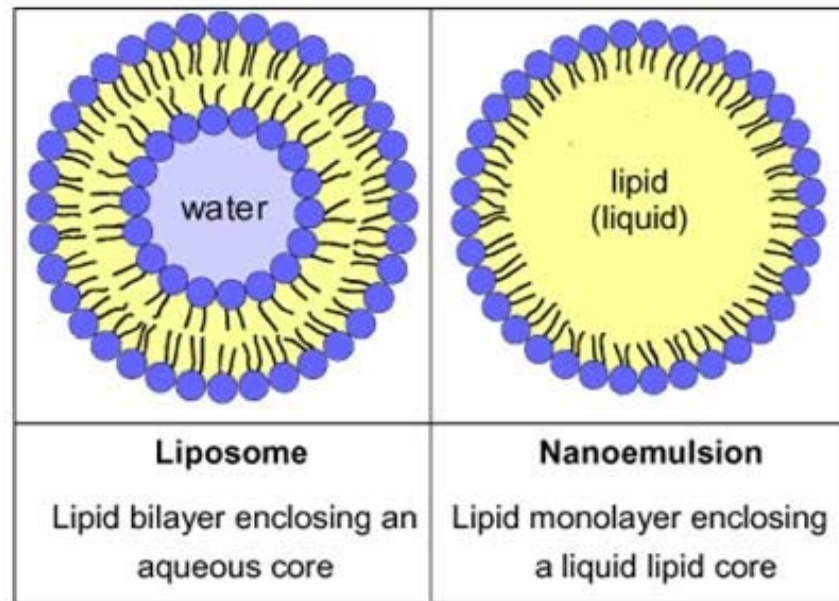
1. Challenges in the consistency and bioavailability of cannabis ingredients
2. Improved consistency and bioavailability
3. How to recognize quality in lipid nanoparticles
4. The latest pharmacokinetic testing data, science and research in nanoemulsion technology



Phospholipid Encapsulation and Nanoemulsions

Two types

- Water core
 - Liposomes
 - Used for C, B vitamins, etc.
- Lipid core
 - Nanoemulsions
 - Used for fat solubles
 - Cannabinoids
 - Terpenes



Lipid Nanoparticles – Consistency Challenges



>300 nm

25 nm

Smaller is Better: How to Recognize Quality



INTENSITY-Weighted GAUSSIAN DISTRIBUTION Analysis (Vesicle)

GAUSSIAN SUMMARY:

Mean Diameter = 309.4 nm

Std. Deviation = 198.0 nm (64.0%)

Norm. Std. Dev. = 0.640

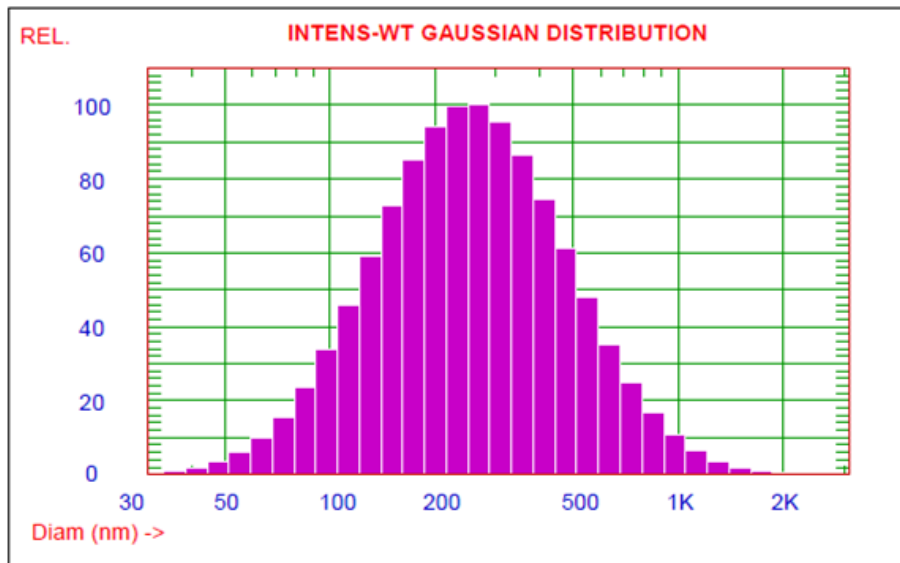
(Coeff. of Var'n)

Variance (P.I.) = 0.410

Chi Squared = 5.269

Baseline Adj. = 0.000 %

Z-Avg. Diff. Coeff. = 1.50E-008 cm²/s



Sample



How to Recognize Quality Nanoemulsions

INTENSITY-Weighted GAUSSIAN DISTRIBUTION Analysis (Solid Particle)

GAUSSIAN SUMMARY:

Mean Diameter = 71.5 nm

Std. Deviation = 41.5 nm (58.1%)

Norm. Std. Dev. = 0.581

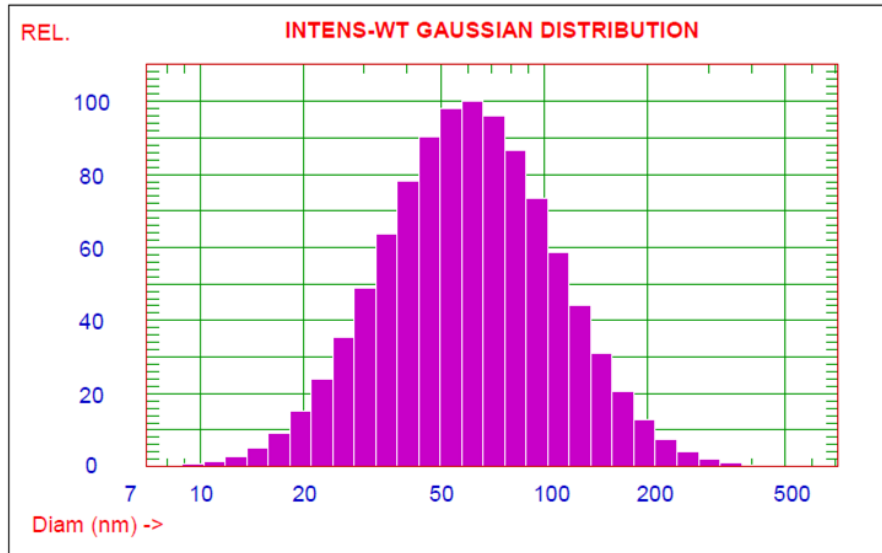
(Coeff. of Var'n)

Variance (P.I.) = 0.338

Chi Squared = 6.746

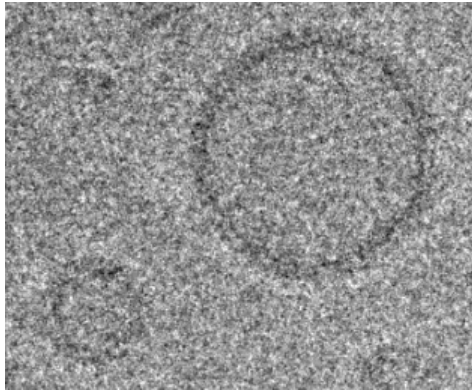
Baseline Adj. = 0.000 %

Z-Avg. Diff. Coeff. = 6.50E-008 cm²/s

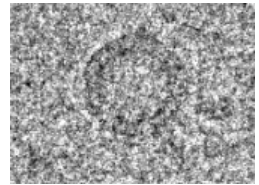
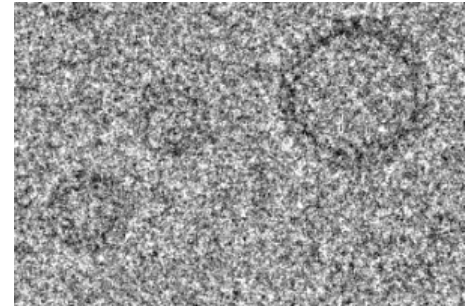
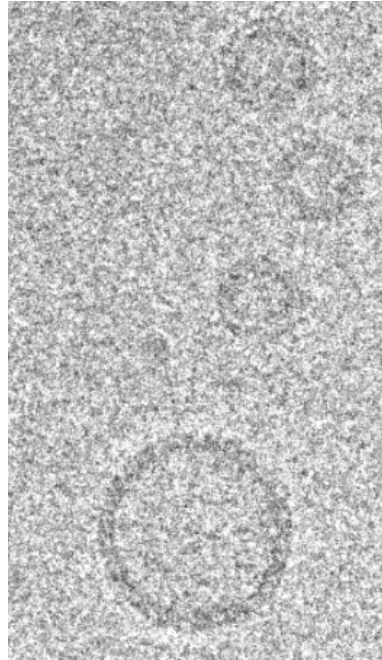
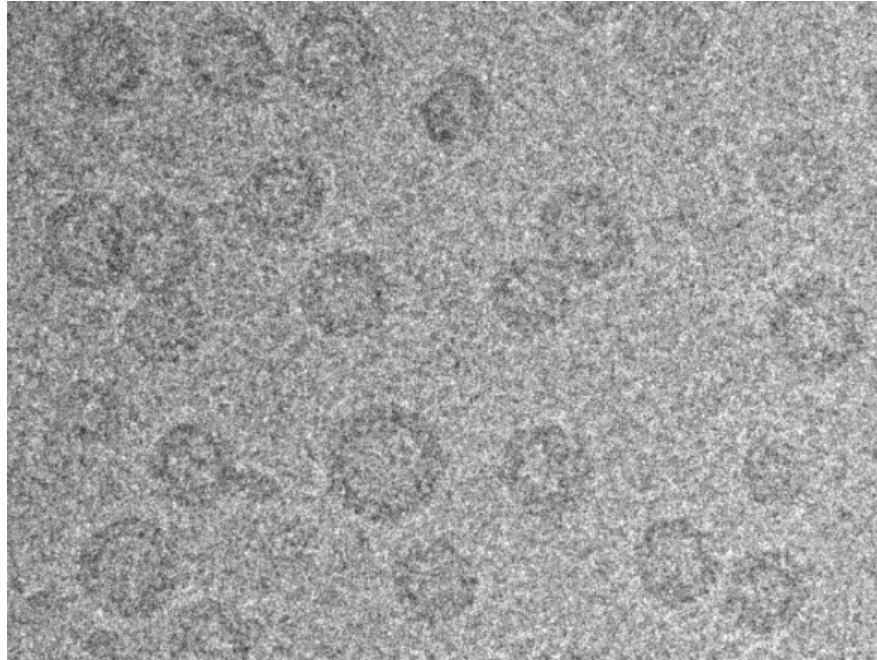


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cryoTEM Images of Nano Emulsified Hemp Oil 100nm bar



Well-made Nanoemulsions

Characteristics:

- Small droplet size
- Stable!
 - thermodynamic stability
 - spontaneous formation
 - “micro-emulsion”

Confer:

- Package stability
- Dispersibility in food matrices
 - macro-scale consistency
- Physical stability
 - meso-scale consistency
- **Superior uptake and availability?**



Nanoemulsion Technology in Different Formats



Beverages



**Tinctures &
Beverage Drops**



Gummies



Topicals



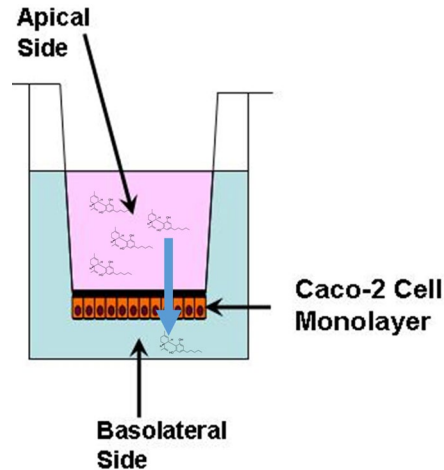
Lozenges



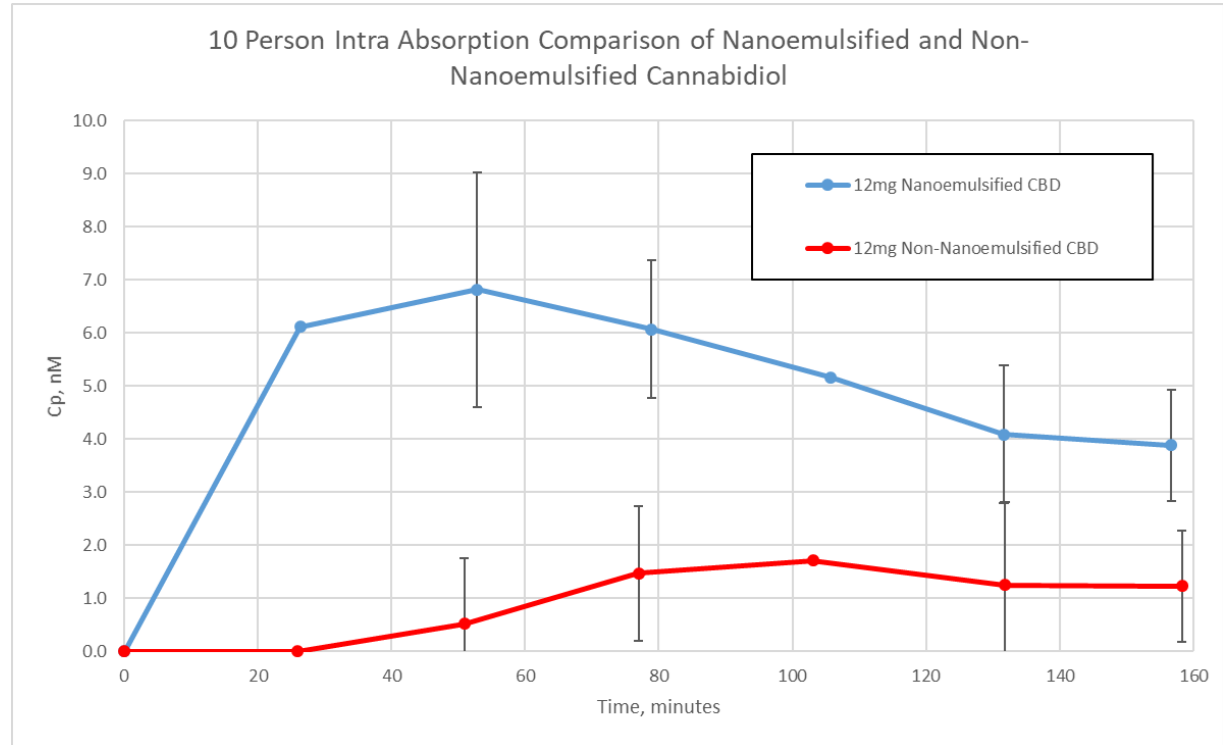
Tablets/Capsules

How to Measure Bioavailability

- Human Uptake Studies
 - Absolute or Relative
- Animal Studies
 - Absolute or Relative
- Caco2 GI permeability assay
 - Relative only

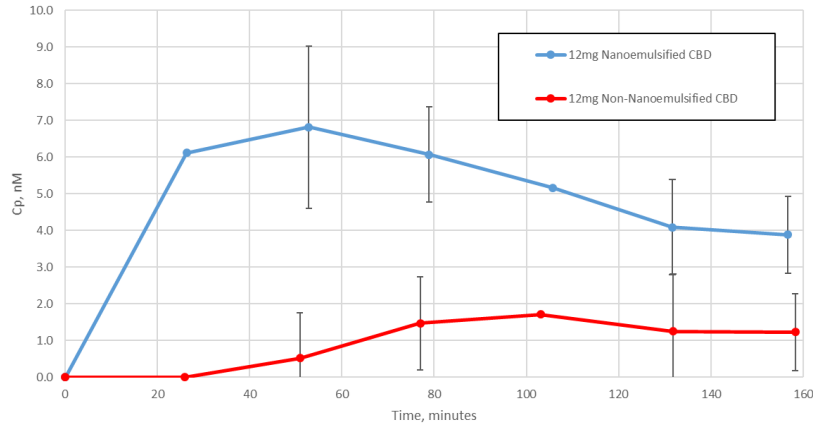


Nanoemulsified Hemp Pharmacokinetic Study

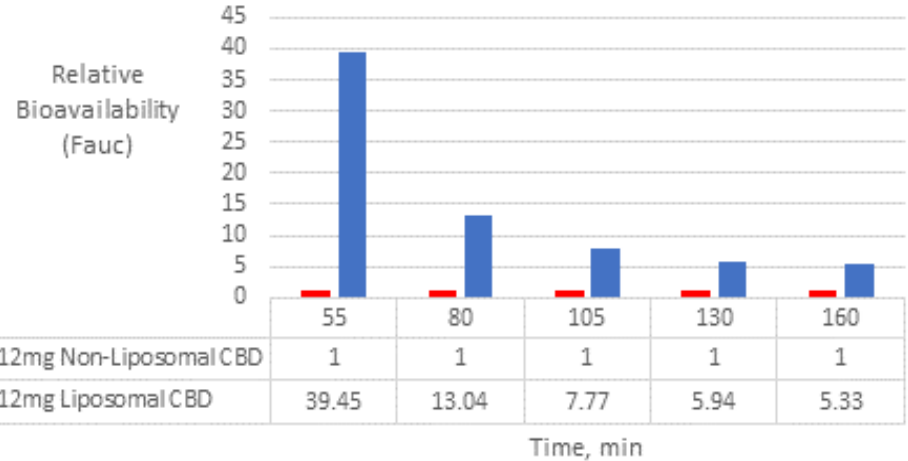


Nanoemulsified Hemp Pharmacokinetic Study

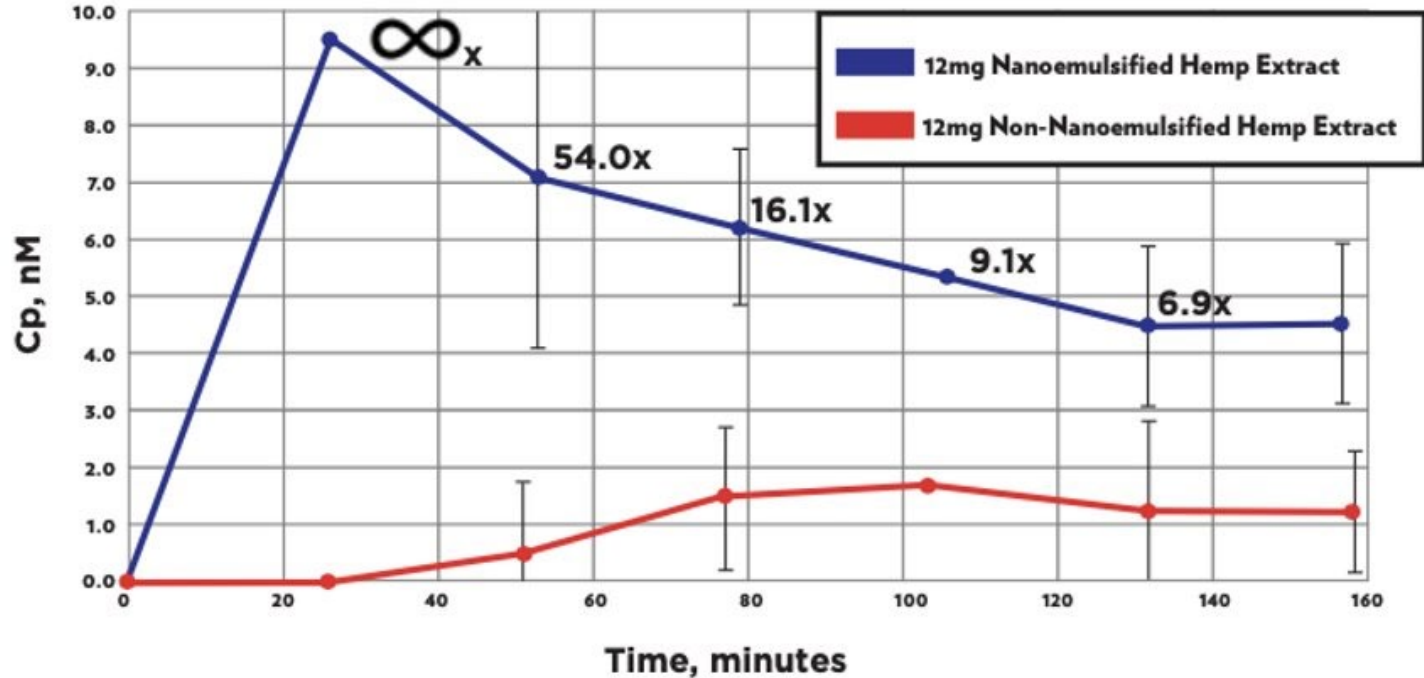
10 Person Intra Absorption Comparison of Nanoemulsified and Non-Nanoemulsified Cannabidiol



10 Person Relative Bioavailability Comparison of Liposomal and Non-Liposomal Cannabidiol



Pharmacokinetic Data – CBD Tincture



Pharmacokinetic Data – CBD Gummies

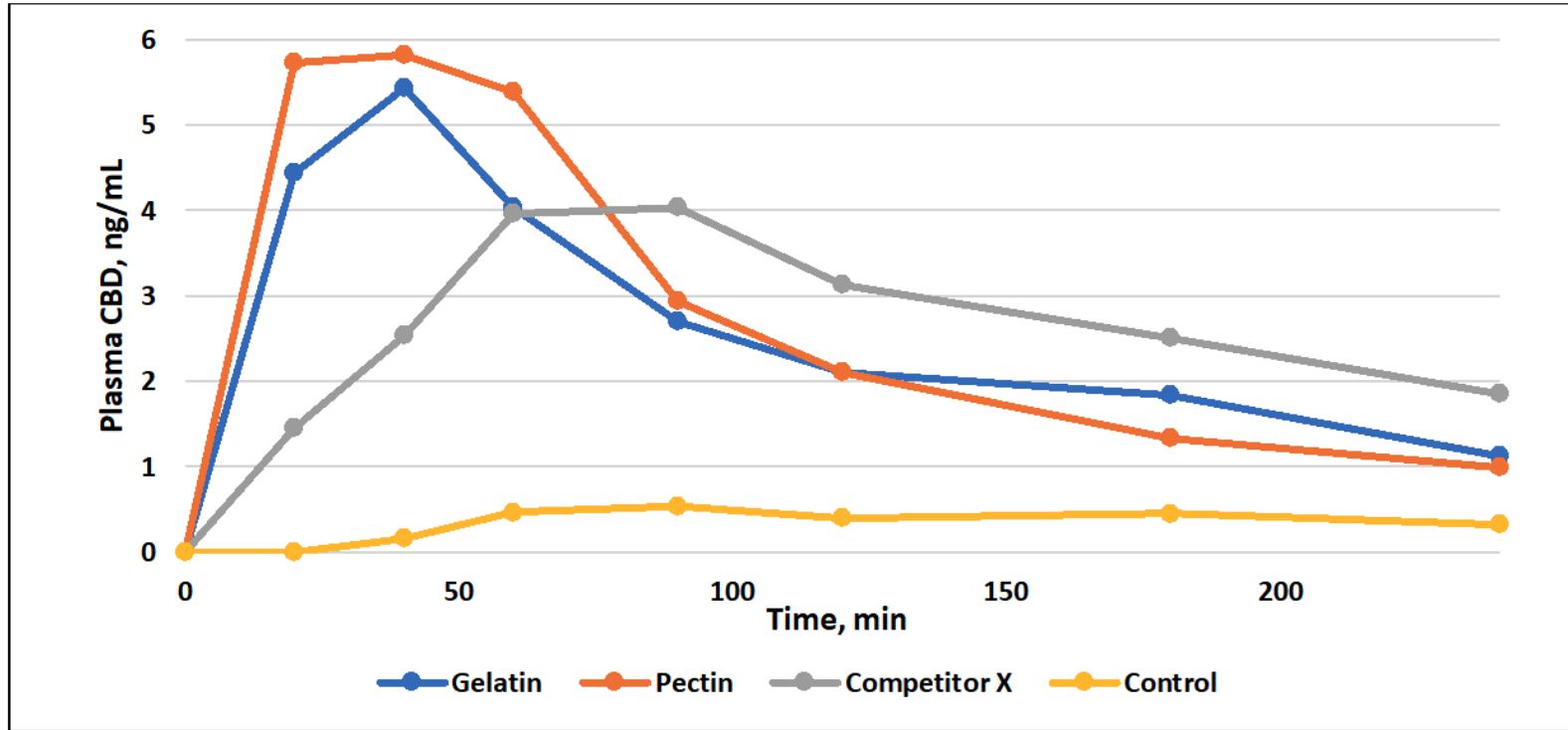
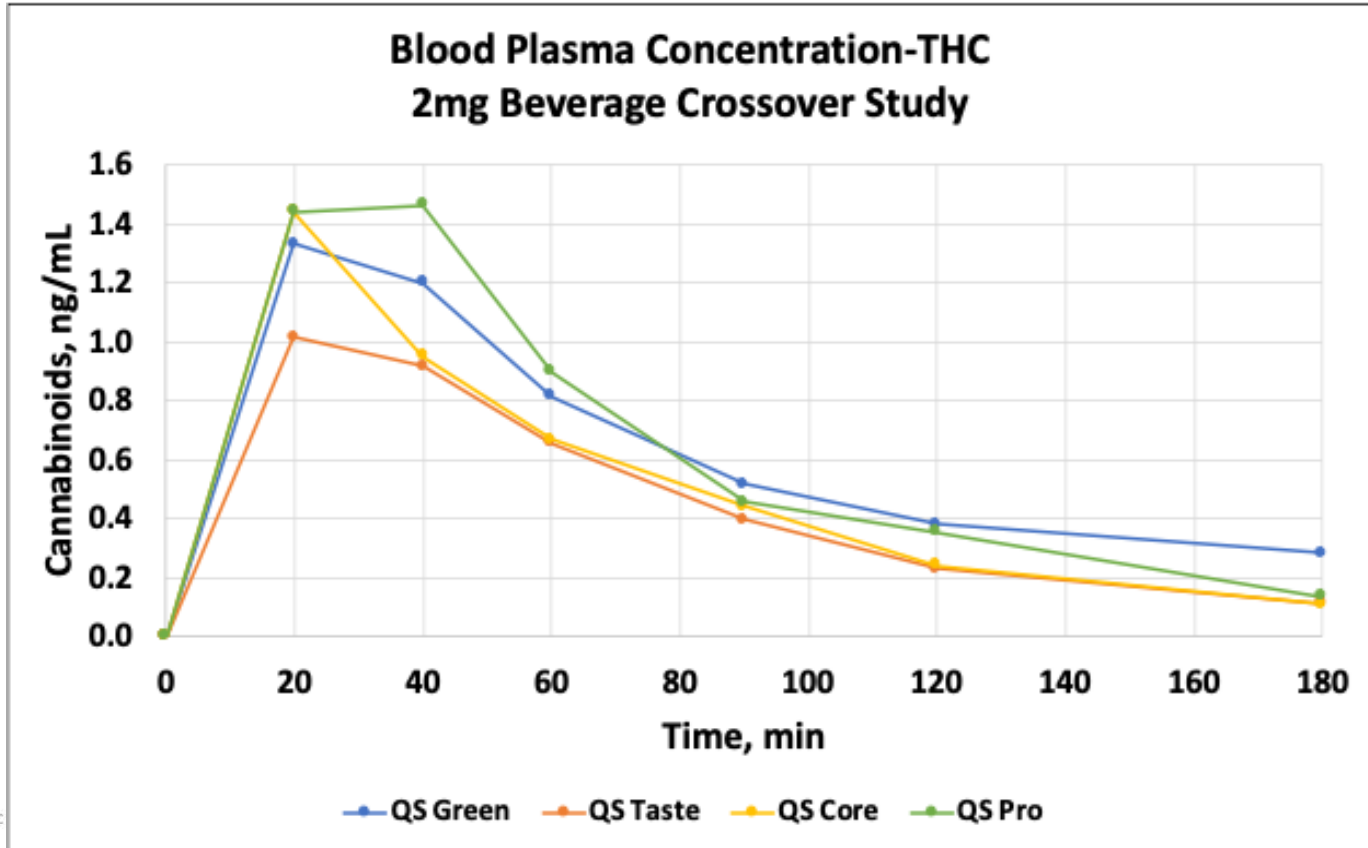


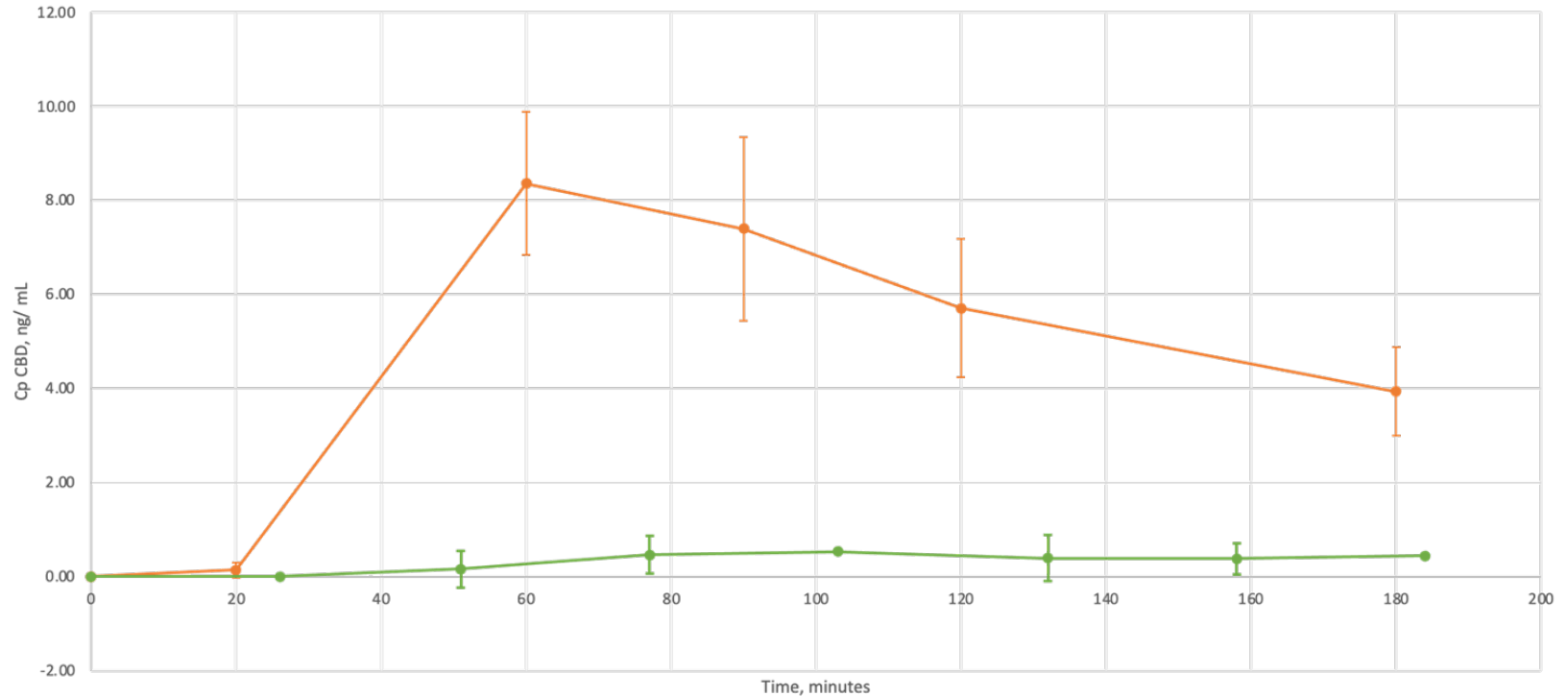
Fig. 2. 12mg CBD in Gelatin, Pectin and Competitor X are from 7-person study. 12mg CBD in Control are from 10-person study. Control is CBD in Hemp Seed Oil.

Pharmacokinetic Data – THC Beverages



Pharmacokinetic Data - Capsule

CBD Plasma Concentration Compared in Enhanced Delivery Systems vs. Non-enhancement



Why Nanoemulsions Work

- Greater Uptake
- Faster Effect/More Efficient
- Repeatability and Controlled Dosing
- Innovative Technology = Product Differentiation

- Increasing ingredient efficacy = lower COGS
 - Improved bioavailability and potency, means less \$\$ spent on pricey key ingredients





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