

Adding Value to Natural Products: Process development

Dr Stephen Tallon, Natural Health Products Suppliers Day, 21st August 2019

An engineering take.....

- » Inputs (what is in the raw material)
- » Outputs (what kinds of products can be made out of them)
- » Processes (how to get there)



Inputs



Carbohydrates

Sugars
Fibre

Proteins

Steroids
Enzymes
Collagen
Growth Factors
Amino Acids
Peptides

Lipids

Oils / Fats
Carotenoids
Flavours
Emulsifiers

Other

Colours
Flavours
Aroma
Antioxidants
Vitamins
Minerals

https://www.naturalhealthproducts.nz/















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HOME MEMBERS INGREDIENTS NEWS EVENTS CAREERS ABOUT CONTACT US JOIN US

That's why our **members'** products are in demand from consumers and manufacturers the world over.

Natural Health Products New Zealand – made from nature.

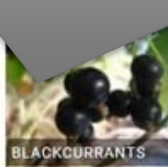
FEATURED INGREDIENTS

 BEE VENOM	 BLACKCURRANTS	 COLOSTRUM	 DEER VELVET	 ENZOGENOL	 FISH OIL
 FLAXSEED OIL	 GRAPE SEED EXTRACT	 GREENLIPPED MUSSEL	 HEMP SEED OIL	 HOROPITO	 KIWIFRUIT
 MANUKA HONEY	 TOTAROL				

Blackcurrants have very high vitamin C content along with potassium, phosphorus, iron, vitamin B5 and a range of other nutrients. They also have phytochemicals such as anthocyanins (or polyphenols). The major anthocyanins in blackcurrant pomace are delphinidin-3-O-glucoside, delphinidin-3-O-rutinoside, cyanidin-3-O-glucoside and cyanidin-3-O-rutinoside. Blackcurrant seed oil is rich in gamma-linolenic acid (GLA), an essential fatty acid, along with many other nutrients.



BEE VENOM



BLACKCURRANTS



COLOSTRUM



DEER VELVET



ENZOGENOL



FISH OIL



FLAXSEED OIL



GRAPE SEED EXTRACT



GREENLIPPED MUSSEL



HEMP SEED OIL



HOROPITO



KIWIFRUIT

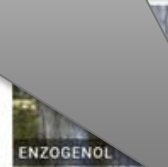
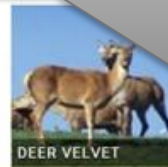


MANUKA HONEY



TOTAROL

Kiwifruit has very high levels of vitamin C and potassium. It also has a wide range of nutrients such as dietary fiber, vitamin E, folic acid, copper, pantothenic acid, calcium, magnesium, iron, vitamin B6 and phosphorus. It has low sodium, low fat and no cholesterol. Kiwifruit extract contains protease enzyme obtained from kiwifruit. The extract has high level of actinidin which mimics the enzyme pepsin in humans. It also contains antioxidants and essential fatty acids.



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 MANUKA HONEY	 TOTAROL				

Polarity

Insoluble

Polar

Non polar

Water

Ethanol

Oil /Hexane / CO₂

Sugars

Proteins

Peptides

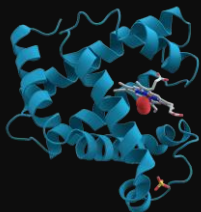
Phenolics

Polar lipids

Oils

Pigments

Salts



(effective) molecular size

Particulate

Cellular

Macromolecules

Single atom

10^{-3}m

10^{-7}m

10^{-10}m

Seeds

Algae

Proteins
Enzymes

Peptides
Free fats
Simple sugars
Globular fats
Oligosaccharides
Polyphenolics
Phenols

Salts

Sediment

Bacteria

Polymers

Viruses
Polysaccharides



Outputs



Performance

Stability
Solubility
Smell
Taste
Efficacy

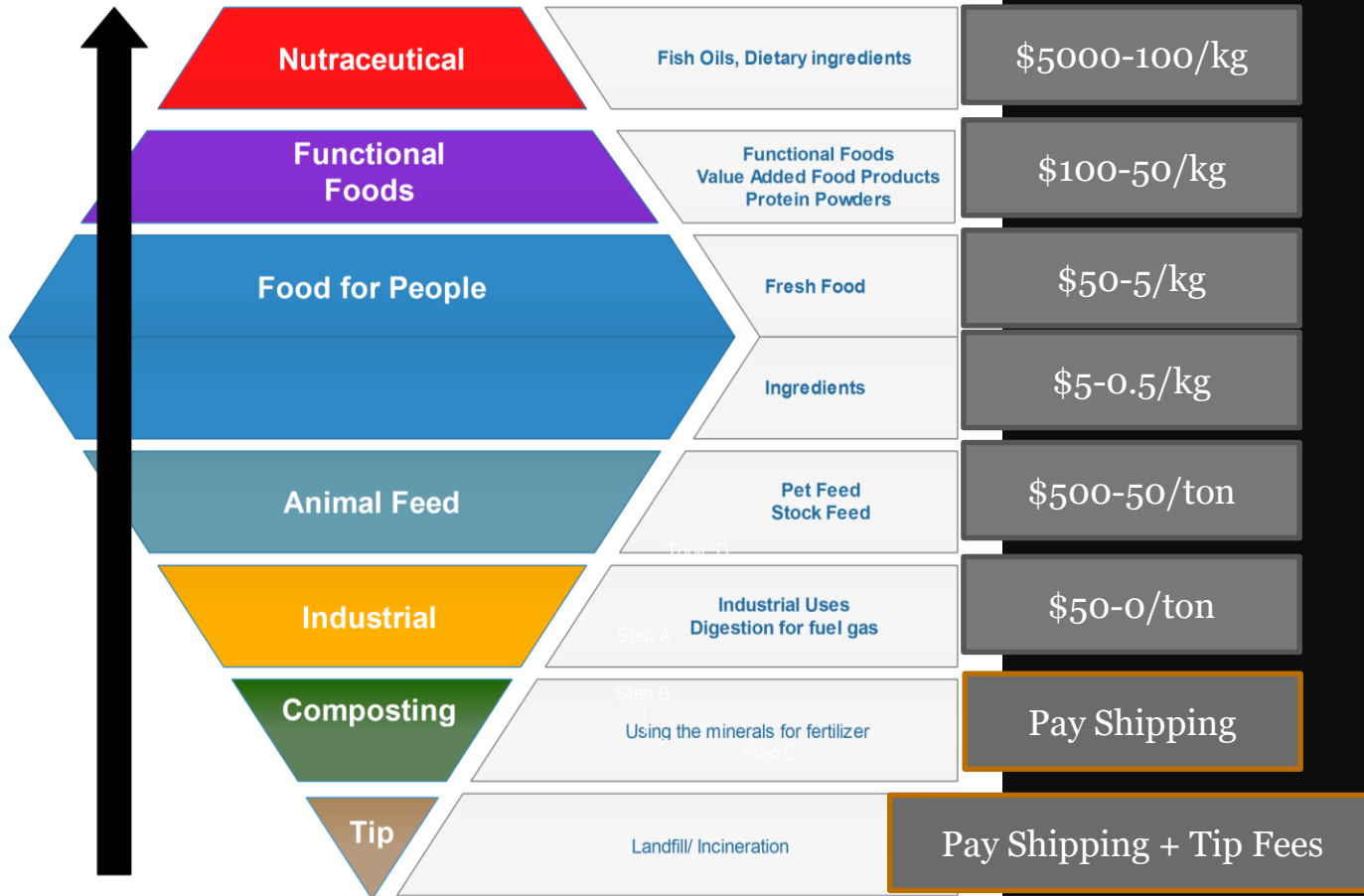
Value

Market size and price
Volumes
Cost to produce

Composition

Product spec
Active constituents
Contaminant limits

Food Value Chain Hierarchy



Outputs

- » Solids / Powders
- » Liquids
- » Other
 - › Suspensions
 - › Emulsions
 - › Gels
 - › Gums
 - › Creams
 - › Pastes



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Processing OPTIONS

Deconstruction

- Physical (e.g. shucking, milling, dehulling)
- Chemical (e.g. enzymatic, chemical hydrolysis, cooking)

Physical separation

- Size (filtration)
- Density (centrifugation)
- Phase change (distillation)

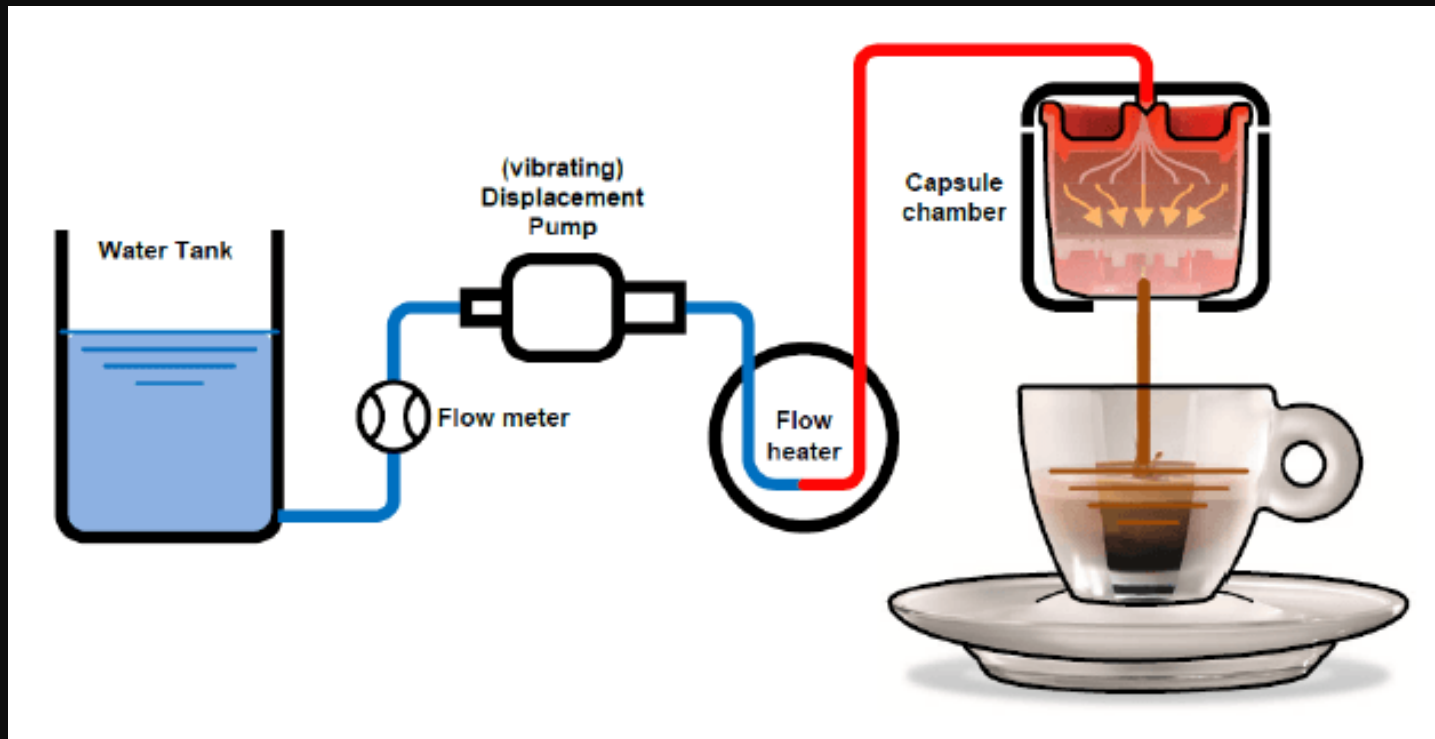
Chemical separation

- Solvent extraction / Crystallisation
- Adsorption
- Chromatography

Finishing

- Drying
- Formulation
- Emulsification

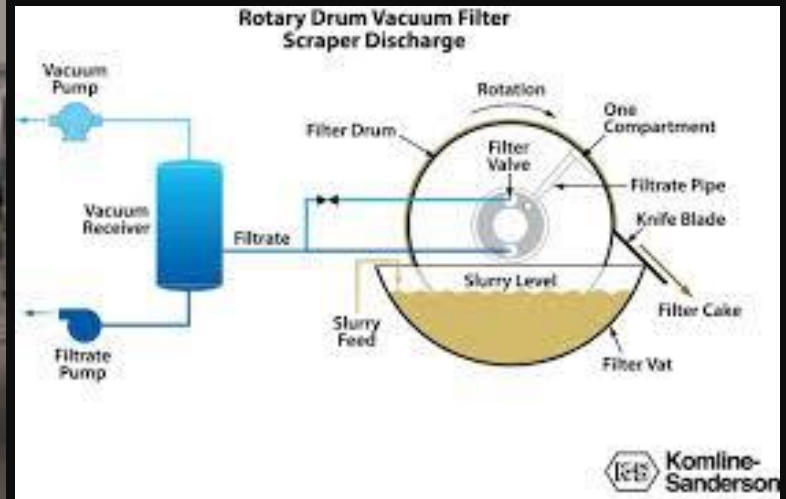
Basic Extraction





**Tweed – Smith's Falls, Ontario,
CANADA
Canopy Growth Corp.**

Vacuum Filter (size separation)



Hemp Extraction Case Study



MODERN USES FOR THE HEMP PLANT



Phytanna defines hemp as: A cannabis plant with an abundance of fiber and **less than .3% THC** (the chemical responsible for the psychoactive effects of marijuana) in the leaves/flowers



SEEDS



FOODS

- ✓ Granola
- ✓ Birdseed



SEED CAKE

- ✓ Animal Feed
- ✓ Protein-rich fiber

Hempseed Oil



FOODS

- ✓ Salad Oil
- ✓ Margarine
- ✓ Food Supplements
- ✓ Vitamins
- ✓ Cooking Oils



INDUSTRIAL PRODUCTS

- ✓ Oil Paints
- ✓ Varnishes
- ✓ Print Inks
- ✓ Fuel
- ✓ Putty



PERSONAL HYGIENE

- ✓ Soap
- ✓ Shampoo
- ✓ Bath Gels
- ✓ Cosmetics
- ✓ Lotions
- ✓ Balms

LEAVES / FLOWERS



CBD

- ✓ Medicine
- ✓ Recreation
- ✓ Sacrament



Cellulose

Abrasive Chemicals

Hemp - AGRICULTURAL BENEFITS



- ✓ Hemp requires less water than most crops
- ✓ Hemp requires less pesticides than most crops
- ✓ Whole Plant
- ✓ Pollen isolation
- ✓ Soil improvement in crop rotation
- ✓ Pyrolysis Feedstock
- ✓ Deep roots are natural soil aerators
- ✓ Boiler Fuel

ROOTS



MEDICAL BENEFITS

Hemp root has been used in folk medicine for millennia, and contains several compounds that may be of medicinal value to many modern ailments, including:

- ✓ Inflammation
- ✓ Pain
- ✓ Arthritis
- ✓ Torticollis (Wry Neck)
- ✓ Hemorrhoids
- ✓ Fever
- ✓ Dysentery
- ✓ Burns/Cuts
- ✓ Stomach Problems
- ✓ Dermatitis
- ✓ Menstruation Pains
- ✓ Bronchitis
- ✓ Asthmatic Problems
- ✓ Sprains
- ✓ Migraine/Headaches
- ✓ Acne
- ✓ Muscular Pains and Cramps
- ✓ More!

STALK / STEM

Bast Fibers



INDUSTRIAL TEXTILES

- ✓ Twine
- ✓ Rope
- ✓ Nets
- ✓ Canvas
- ✓ Tarps
- ✓ Carpets
- ✓ Caulking
- ✓ Geotextiles
- ✓ Agro-Fiber Composites & Molded Parts
- ✓ Brake/Clutch linings



CONSUMER TEXTILES

- ✓ Apparel
- ✓ Diapers
- ✓ Fabrics
- ✓ Handbags
- ✓ Denim
- ✓ Shoes
- ✓ Fine Fabrics

Hurds (Pulp)

Hurds (Pulp) & Bast Fibers



BUILDING MATERIALS

- ✓ Animal bedding
- ✓ Cement
- ✓ Fiberboard
- ✓ Insulation
- ✓ Fiberglass Substitute
- ✓ Mulch and Compost
- ✓ Stucco & Mortar



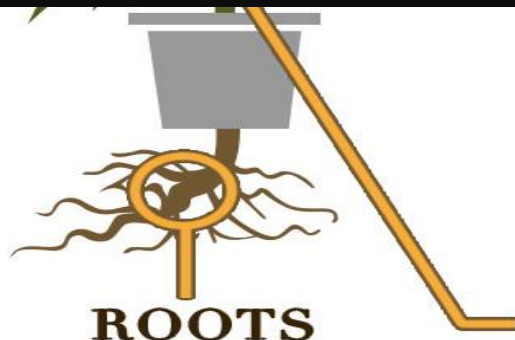
PAPER

- ✓ Printing Paper
- ✓ Newsprint
- ✓ Fine/Specialty Paper
- ✓ Cardboard/Packaging
- ✓ Filter Paper

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Hemp - A



STALK



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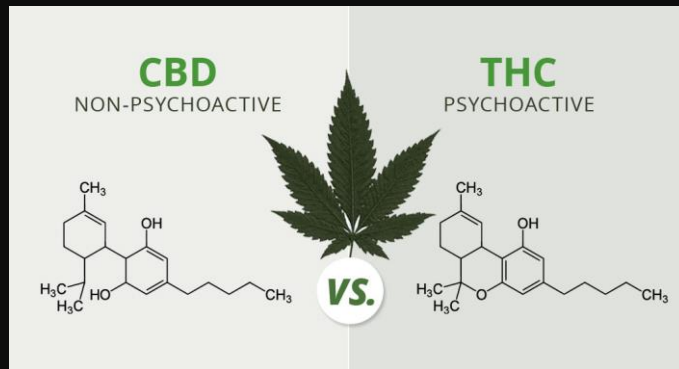
Cell Fluids

- ✓ Abrasive Chemicals



Inputs

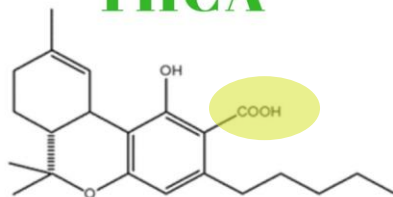
Cannabinoids



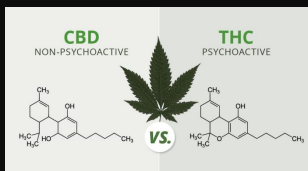
Inputs

Cannabinoid acids

THCA

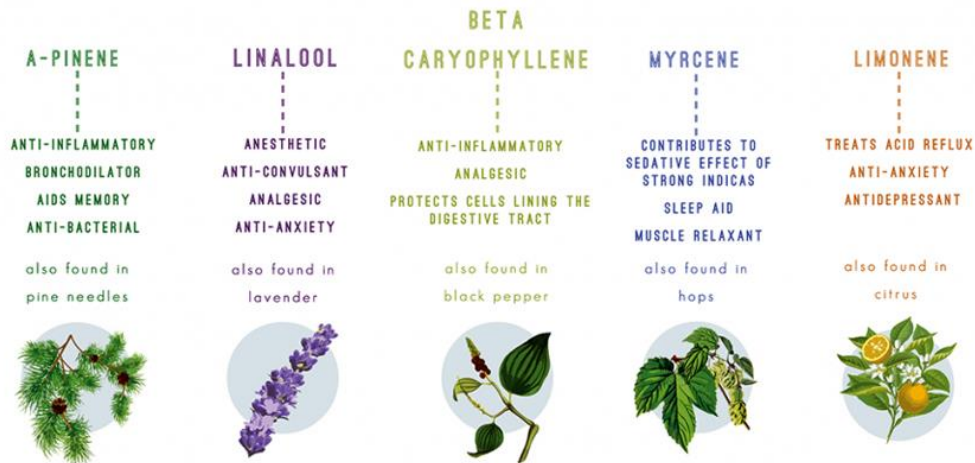


Tetrahydrocannabinolic acid



Inputs

Terpenes



Inputs

Waxes, fatty acids, chlorophylls, (pesticides)



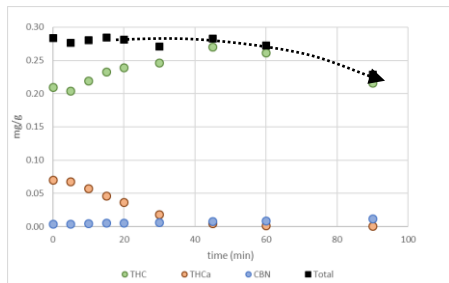
Processing - Decarboxylation



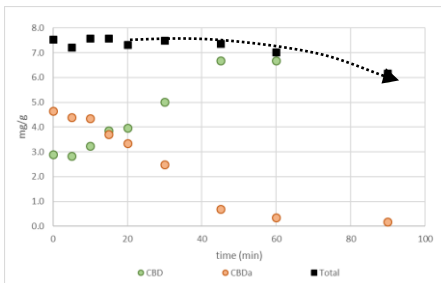
Process - Decarboxylation

120°C

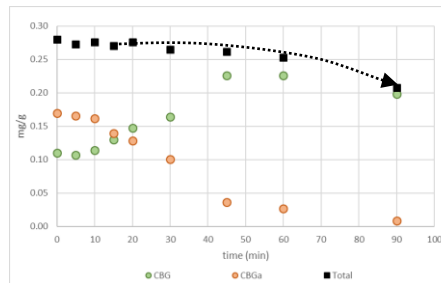
THC, THCA, CBN



CBD, CBDA

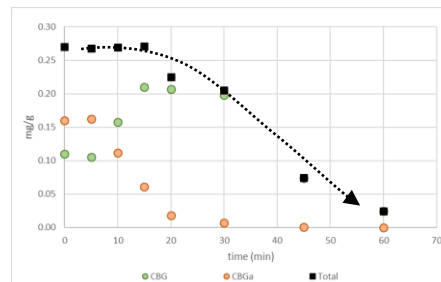
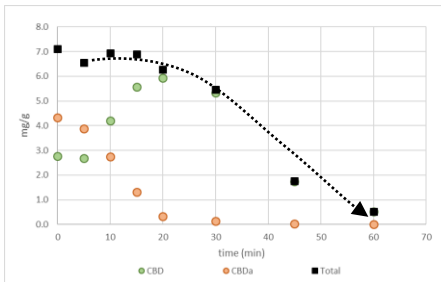
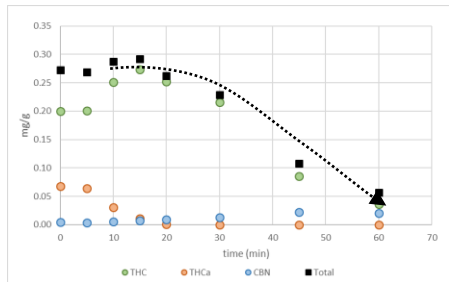


CBG, CBGA



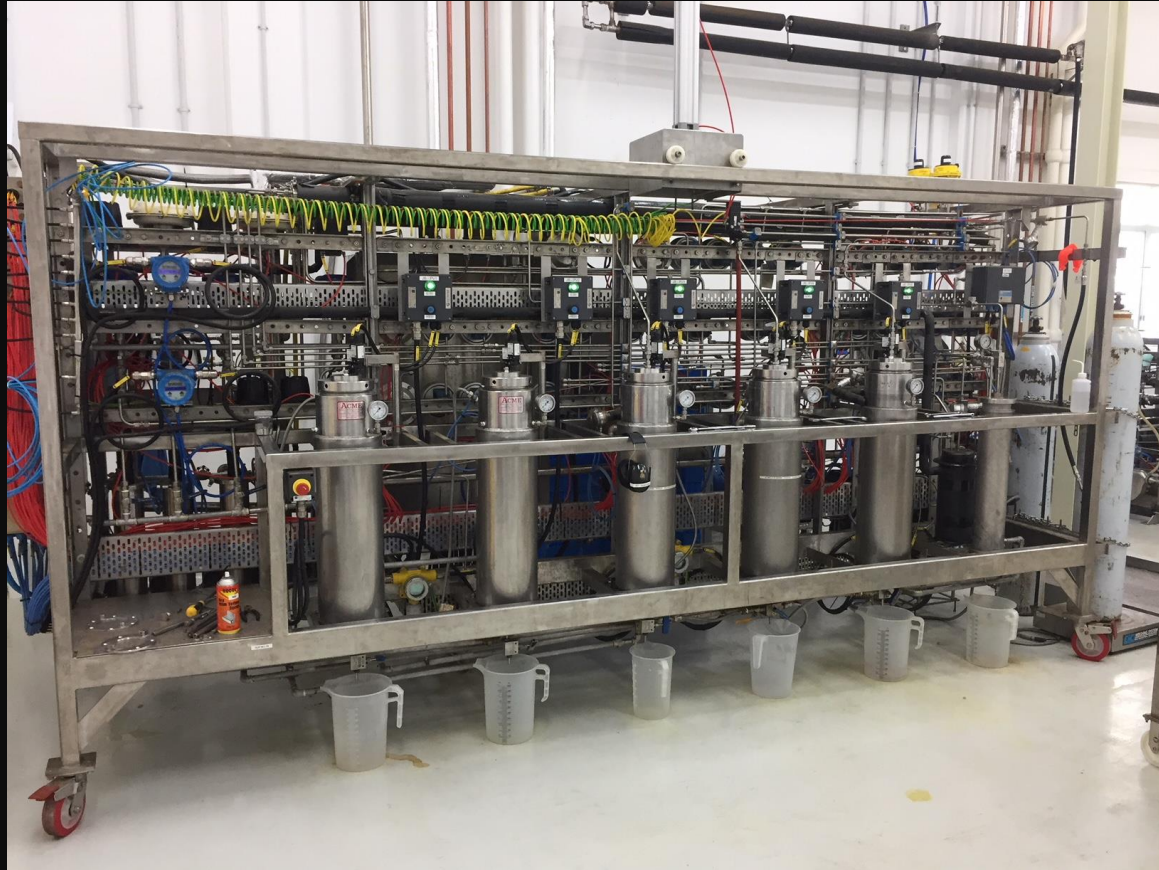
- ✓ *Faster reaction*
- ✓ *Total concentration starts to decrease at longer times*

160°C



- ✓ *Decarb'n complete in ~20min*
- ✓ *Sharp decrease in total concentration after that*

Process - Extraction

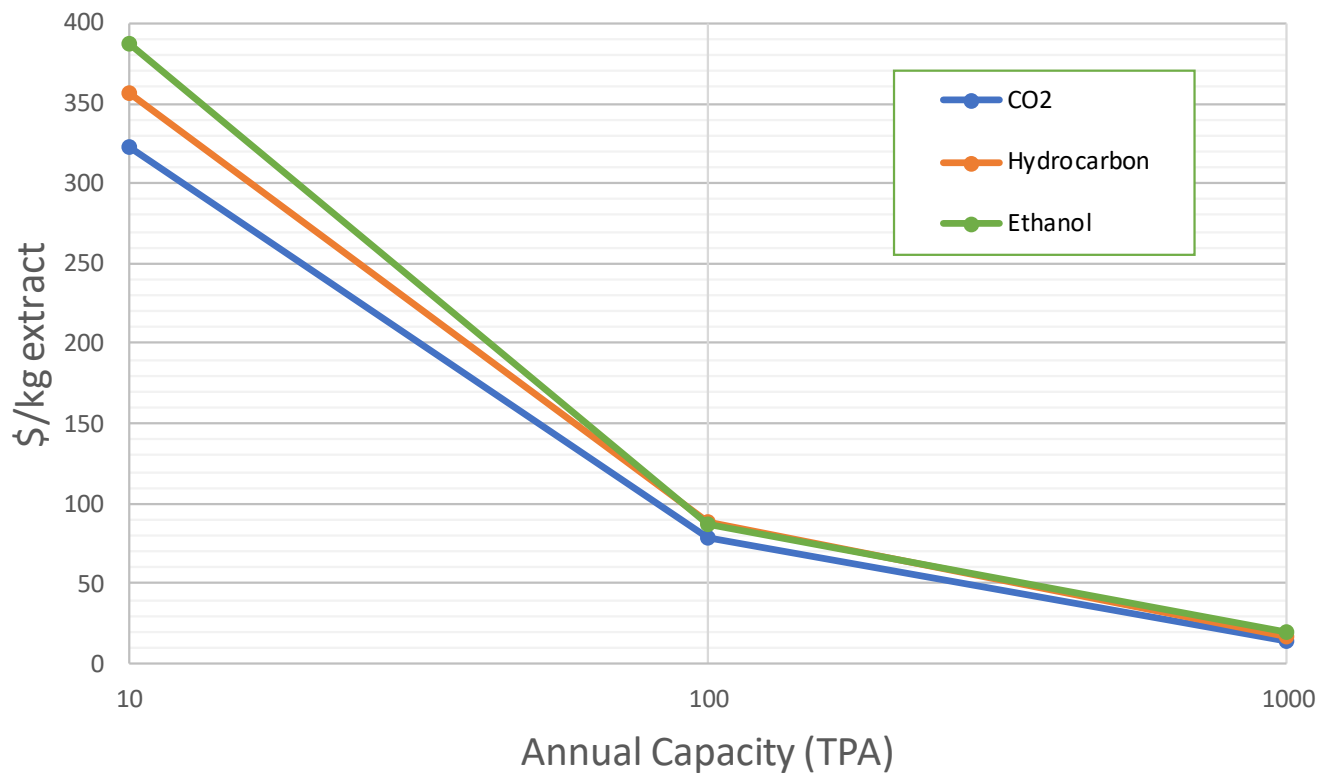


Solvent comparison

Ethanol	CO ₂	Hydrocarbon
Broad range	Selective extraction	Narrow range
Flammable	Not Flammable Solvent free	Flammable
Cost: moderate	Cost: moderate	Cost: moderate



Unit cost of processing (\$/kg extract @15% yield)







Canna Bees



RESCUE BLEND™

NET WT. 4.65 oz (131g)

RAW HONEY +

250^{mg}

CBD

HEMP EXTRACT



FOOD-RELATED CANNABIS PRODUCTS



HEMP SALVE USING DECARBED FULL SPECTRUM EXTRACT



That's Natural! CBD-Rich Hemp Oil

Before



**Anxiety
Stress
Joint Pain
& More!**

After





Our services for business

► R&D



► Innovation skills



► Grants



Research and development (R&D)

- » Advanced materials
- » Biotechnologies
- » Advanced manufacturing
- » Internet of Things & Data Solutions



Innovation skills programmes

- » Better by Lean
- » Build for Speed
- » Driving Innovation
- » High Performance Working Initiative
- » Rukuhia (pilot) – Building innovation culture
- » Innovation IP



R&D Grants

- » Getting Started
- » Project Grants
- » Growth Grants
- » Student Grants:
 - » Experience
 - » Fellowship
 - » Career



Callaghan
Innovation

Aotearoa
Innovation
Agency

Liberating **INNOVATORS**