LIGNIN-BASED CO-FORMULANTS IN BIOCONTROL FORMULATIONS

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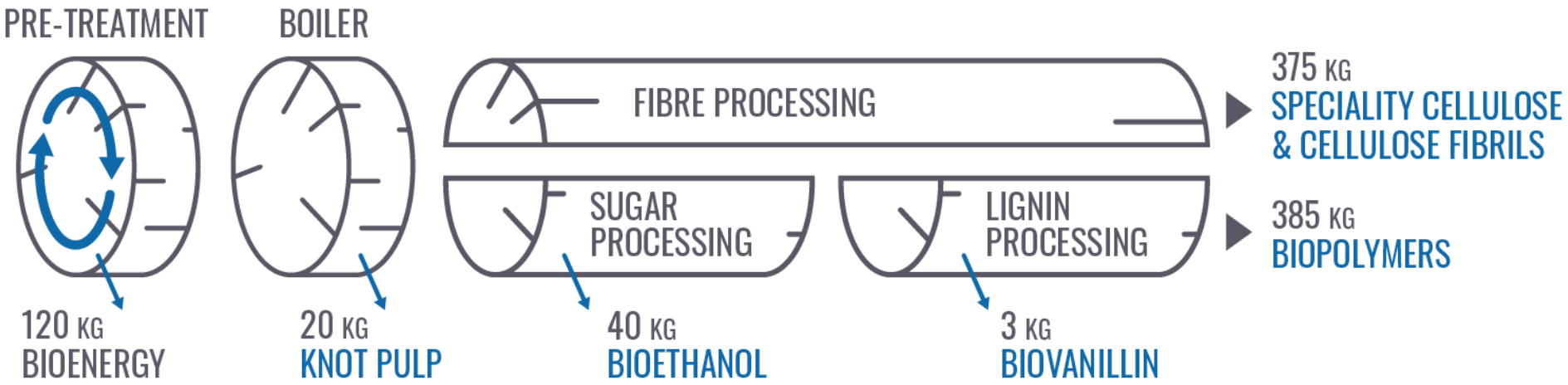
Borregaard Biorefinery - High Utilization of Raw Materials

1000 KG
WOOD

94%
UTILISATION



EMPLOYEES

1100

PRODUCTION

- Biopolymers
- Speciality cellulose
- Bioethanol
- Biovanillin
- Cellulose fibrils
- Fine chemicals

800
PRODUCTS

RAW MATERIAL

1 MILLION

m^3 Norway Spruce
375.000 tonnes lignin raw material

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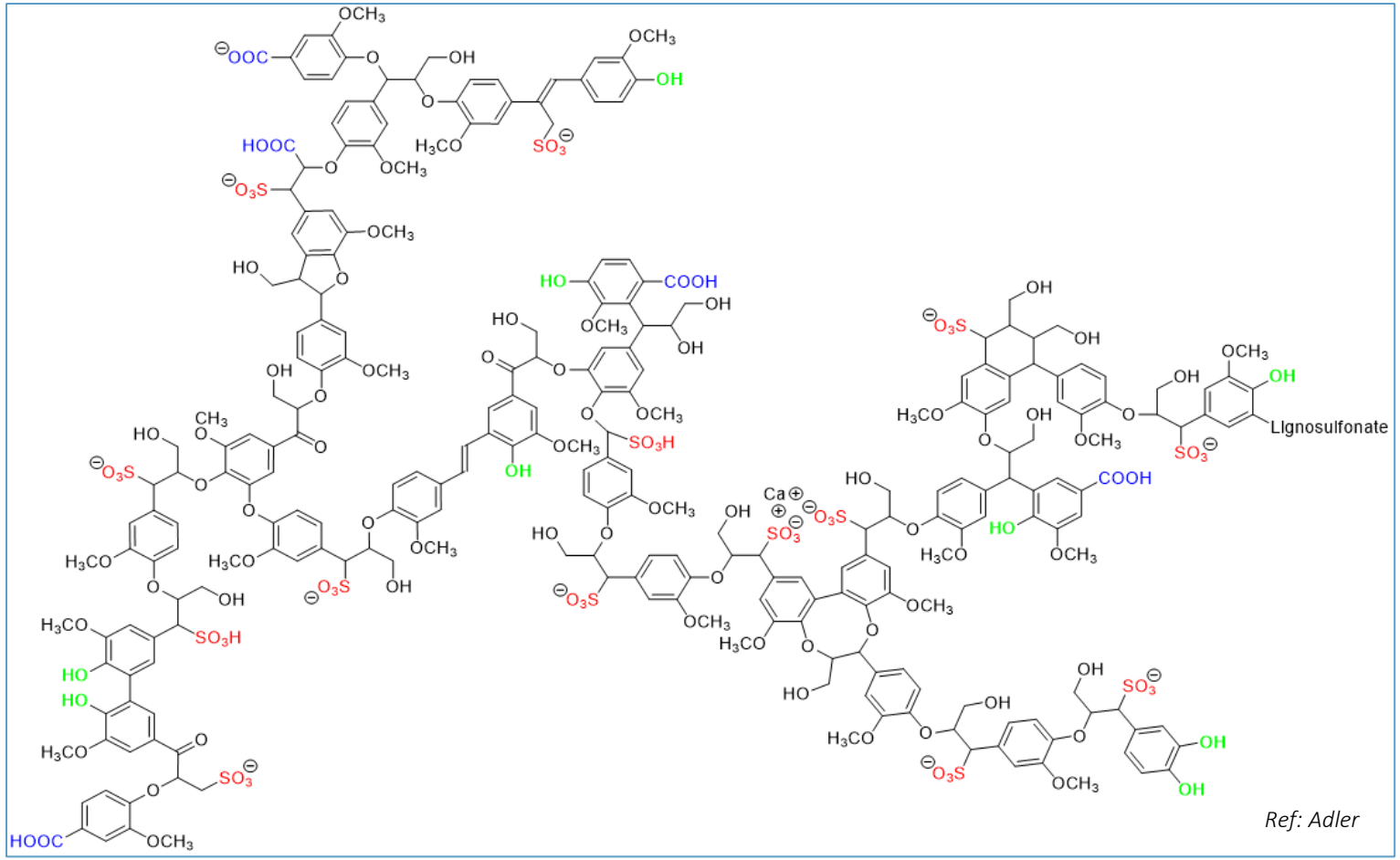
Lignosulfonates in Biocontrol



- **Benefits of lignosulfonates as co-formulant**
  - → Dispersing/ binding and suspensibility
  - → Microbial compatibility
  - → UV-protection
- **Key products**
  - → Vanisperse CB
  - → Ultrazine NA
  - → Ufoxane 3A

Global biocontrol market will exceed $15 billion by 2029 (DunhamTrimmer®)

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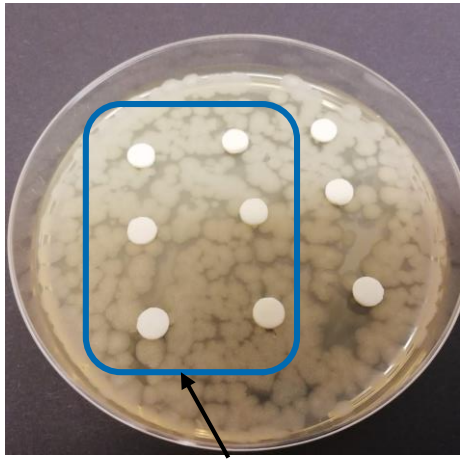
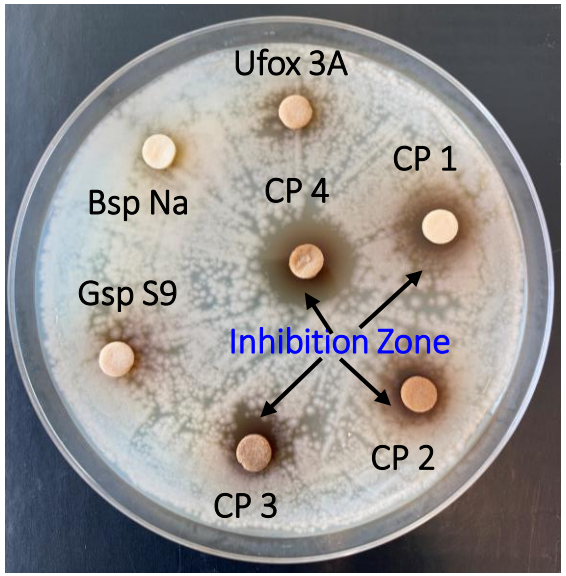
1. Microbial Compatibility: Lignosulfonates & Cellulose Fibrils/ Exilva

- Compatibility study – **Filter paper tests (qualitative)**
- No inhibition zone around lignosulfonates (10%) and cellulose fibrils – compatible
- Inhibition zone with competitor products (CP) – Incompatible



Cellulose Fibrils

- Microorganism tested –
  - ***Bacillus thuringiensis (Bt)***
  - *Beauveria bassiana*
  - *Pseudomonas fluorescens*
  - *Metarhizium anisopliae*



Bt culture on Nutrient Agar plate with 10% lignosulfonates

- Lignosulfonates tested – Vanisperse CB, Ufoxane 3A, Greensperse S9, Ultrazine Na

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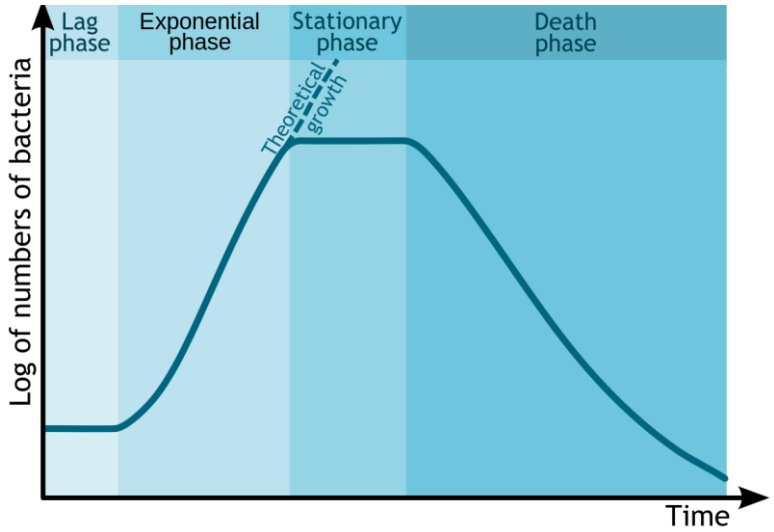
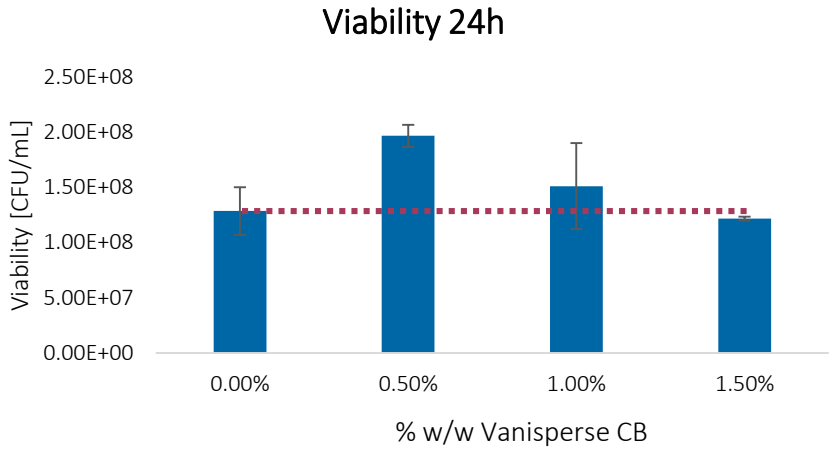
1. Microbial Compatibility: Lignosulfonates (Quantitative)

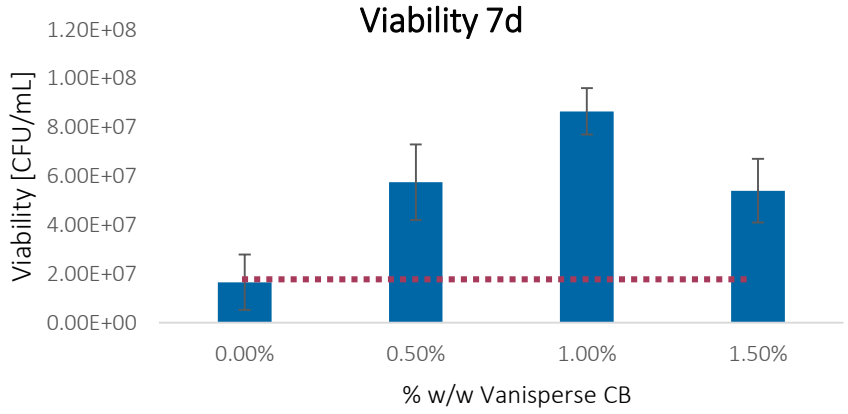
- **Quantitative** – Colony Forming Units (CFU) count



- ***Bacillus thuringiensis*** **(Bt)** in stationary phase, incubated with Vanisperse CB (24h -7d) with varying concentration

- Viability on prolonged incubation period (7 day)





Data represent mean and spread from duplicate experiments.

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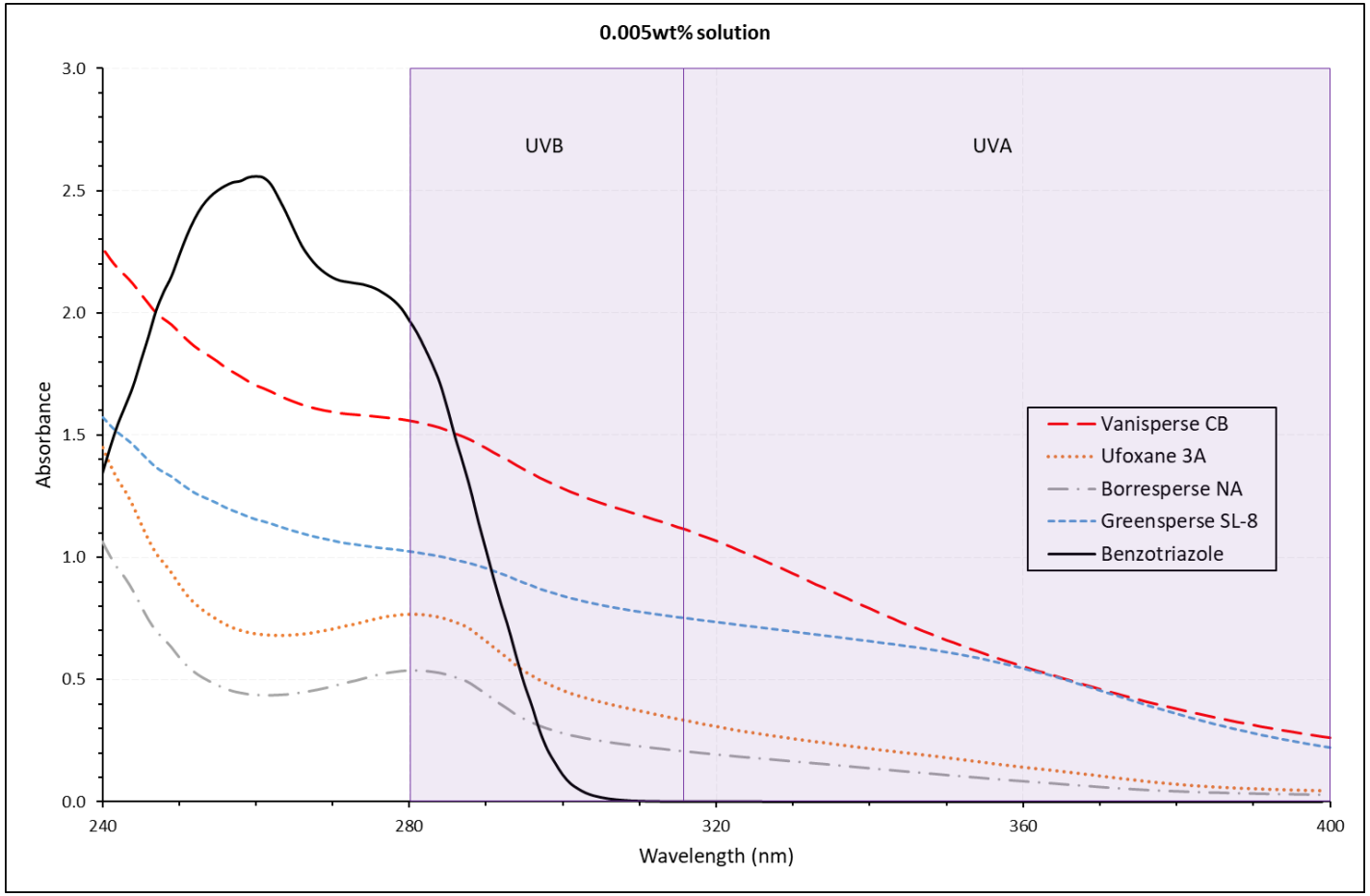
2. UV-Protection: Lignosulfonates



Atlas Suntest XLS+

- *Bt* suspension in Vanisperse CB, in artificial sunlight simulator
- Radiation time 4 hr, 300-400 nm, irradiance W/m^2 = 27; temperature ≈ 40°C

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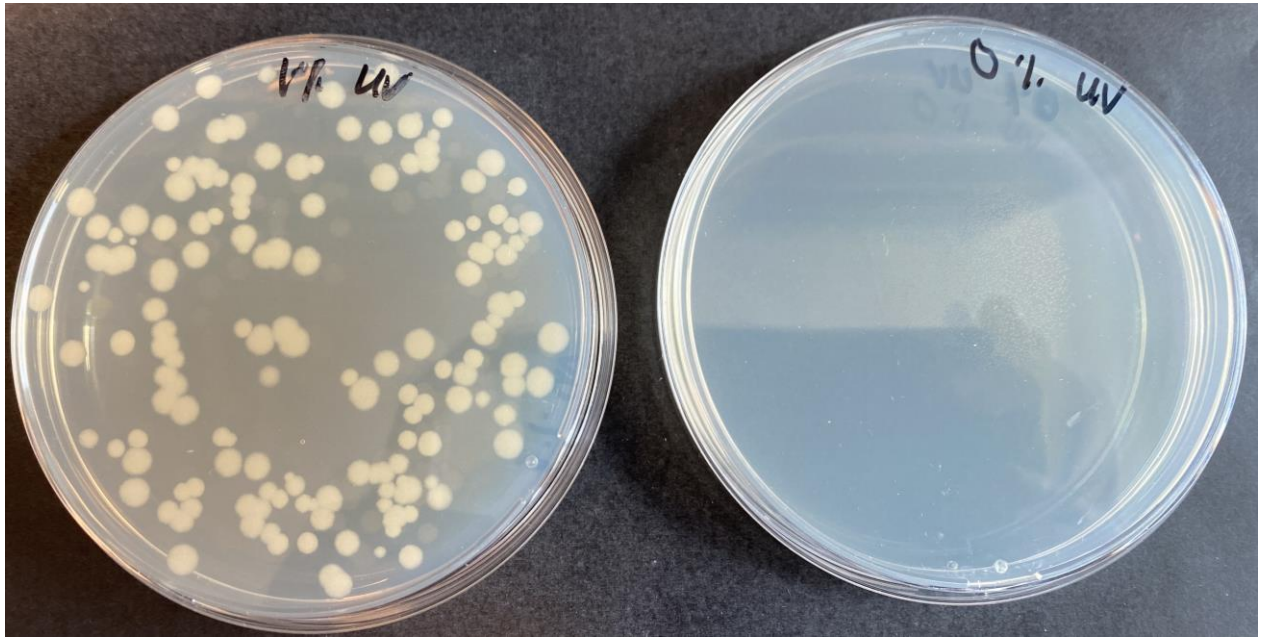
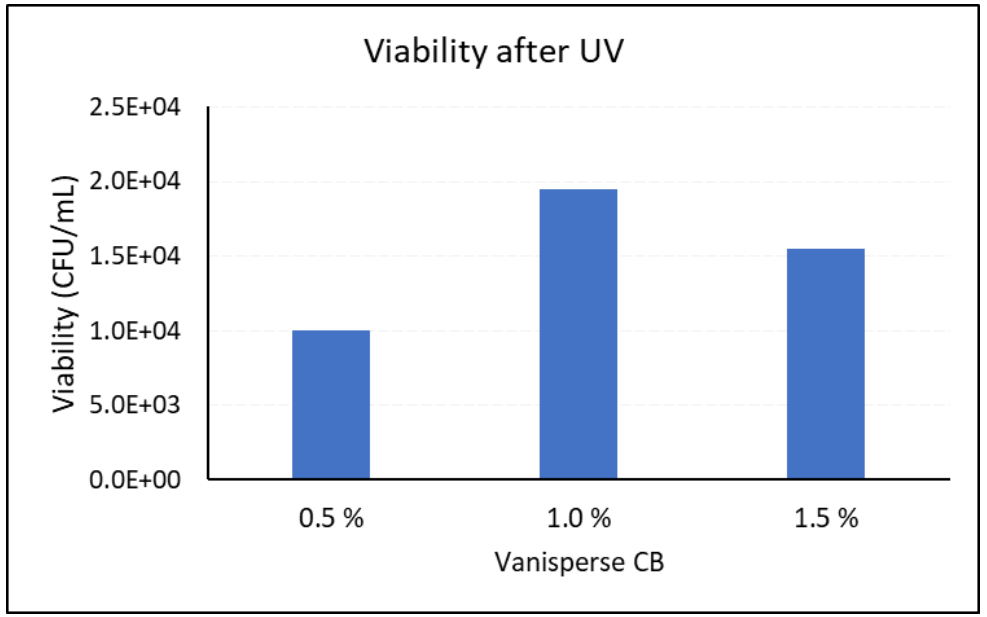
2. UV-Protection: Lignosulfonates

- Viability of *Bt* with Vanisperse CB (1%) after 4 hr UV-exposure
- No viability observed on control



1% Vanisperse CB

Without Vanisperse CB



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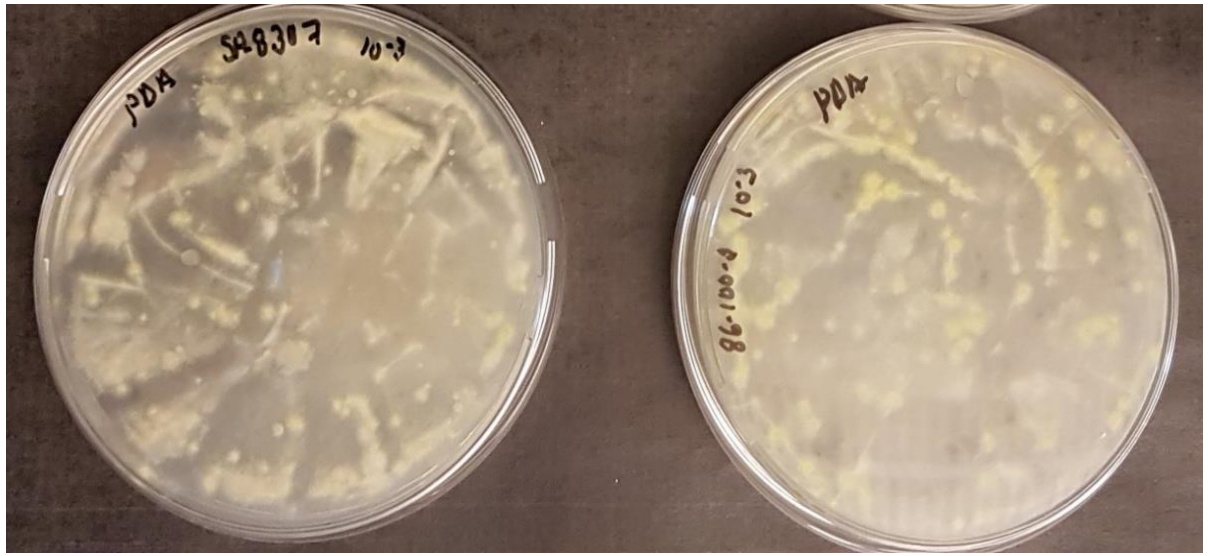
3. Formulation Example: Spray Dried WG

- Spray-dried ***Beauveria bassiana*** – at low temperatures (60/30°C)
  - → Good dispersion of conidia
  - → Viability is maintained after drying



before drying

after drying

Ingredients	wt%
B. bassiana	70
Lignosulfonates	28
Wetting agent	2
Filler	-

Dispersant (Lignosulfonates)	Suspensibility (%)
Vanisperse CB	88
Ultrazine NA	98

Suspensibility of the granules

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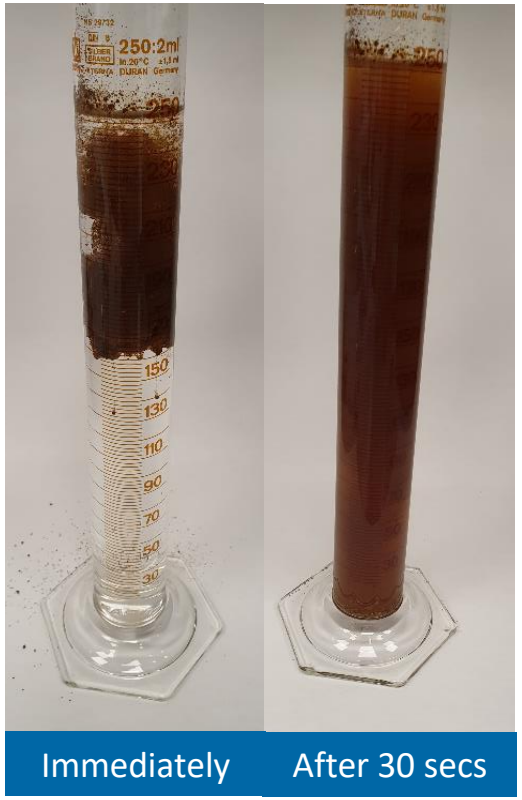
3. Formulation Example: Fluid Bed Granulated Peptide

- Granulated formulation –
  - → Lignosulfonates provides good binding
  - → High suspensibility (85%) and good dispersibility (15-20 inversions)

Ingredients	wt%
Peptide	30
Microbe	50
Van CB	17
Maltodextrin	3



Immediately | After 30 secs

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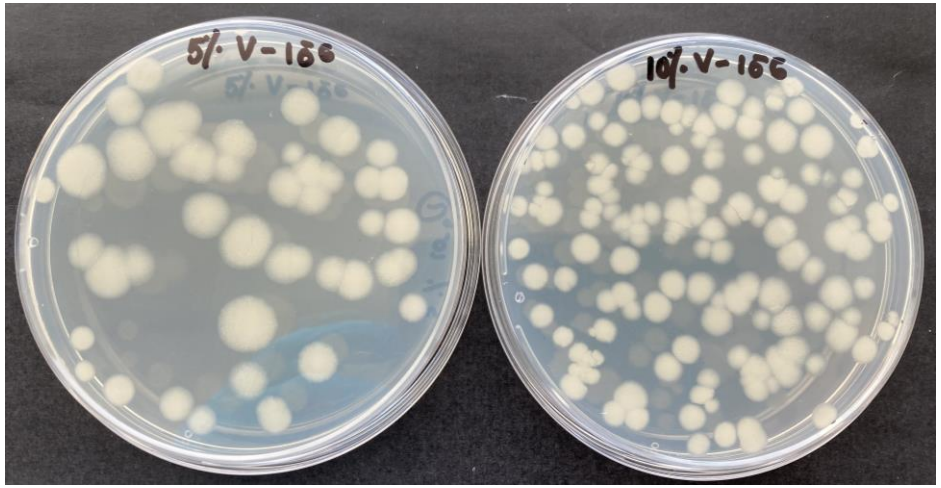
3. Formulation Example : Wettable powder (WP)

- Spray dried ***Bacillus thuringiensis* (*Bt*)** at low temperature

- Vanisperse CB as an in-built adjuvant in WP
  - → Excellent suspensibility
  - → UV-protection

- *Bt* suspension with Vanisperse CB (5% and 10%)
  - → UV exposure – 4 hr
  - → CFU = 4,5x 10^7 / mL for 5% Vanisperse CB
  - → CFU = 13x 10^7 / mL for 10 % Vanisperse CB



*Ongoing work

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Conclusions

- Borregaard's lignin-based co-formulants and Exilva Cellulose Fibrils are biobased, microplastic free, REACH-exempt.

- Lignosulfonates showcase excellent compatibility with microbes, viability is maintained over prolonged period.

- Vanisperse CB as a co-formulant can bring
  - → Excellent suspensibility
  - → Microbial compatibility
  - → UV-protection

- Ongoing activity
  - → Expand Biocontrol workspace – evaluating other prototypes and microbes
  - → Plant nutrition & Biostimulant – Growth Chamber

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Biocontrol Team

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Researcher

Vera Novy
Researcher

Sumit Ganguly
Researcher

Questions?