

Enhance Probiotic Product Stability with Customized Active Packaging Solutions



François Bidet | VP Business Development EMEA | December 2020

About Aptar CSP Technologies



- Headquarters Auburn, Alabama, USA, with global footprint
- Material science specialist delivering innovative, highly-engineered, active packaging solutions
- + 1 billion components manufactured annually, 5 manufacturing locations worldwide
- + 500 worldwide patents
- Active in pharmaceutical, diagnostics, probiotics and food safety



Auburn, AL USA



Guangzhou, China



Atlanta, GA USA



Niederbronn-les-Bains, France

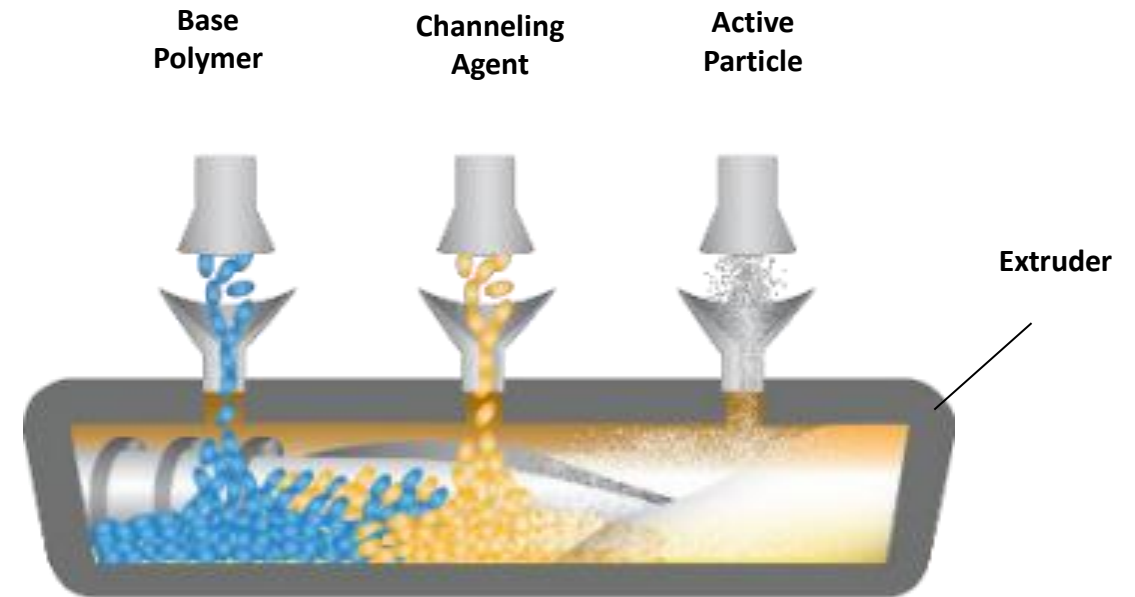
3-Phase Activ Polymer™ Material Science

3-Phase Activ-Polymer™ Material = Platform Material

Material Science: Adding Chemistry to Polymers

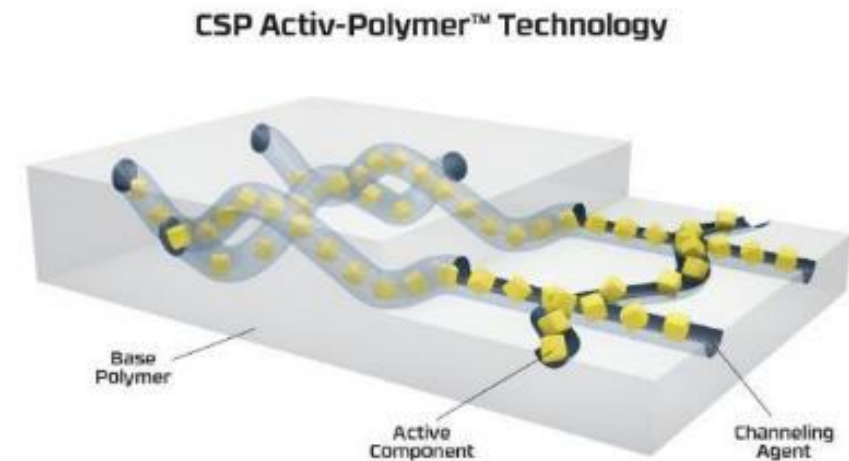
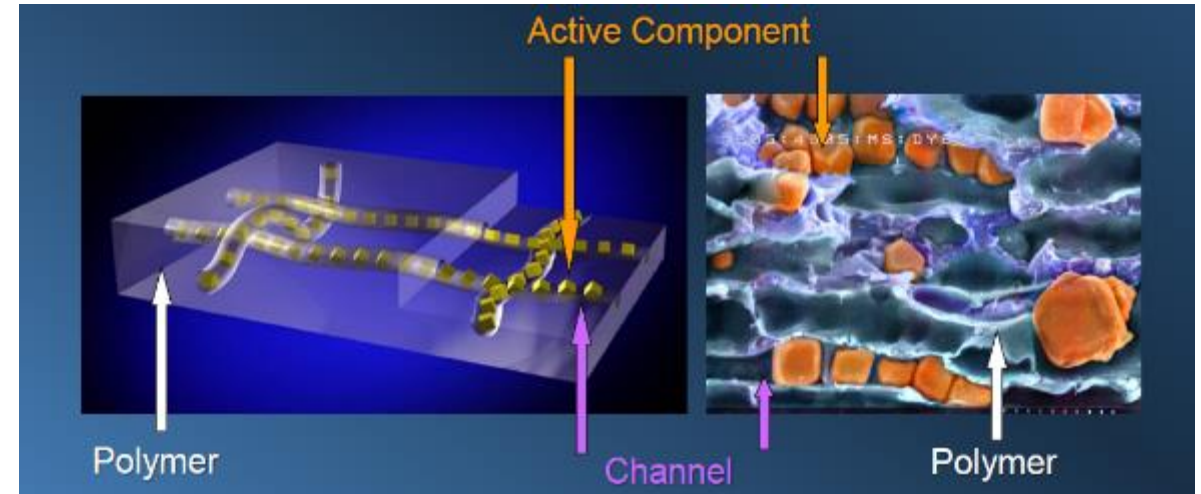
3-Phase Polymers

1. **Majority Polymer**: Base structure component
2. **Particle**: Adsorbing/absorbing – active component
3. **Minority Polymer/Channeling Agent**: Immiscible in majority polymer



Material Science: Adding Chemistry to Polymers

- Channels created within a polymer allow movement of gases
- “Active” particles are added to the polymer in order to:
 - **Adsorb** or **Absorb** (moisture, gases, reactive impurities, odors, formaldehyde and other volatiles)
 - **Release** (aromas, biocides, nutrients, carbon dioxide)
- **Gas diffusion** is controlled through the channel composition

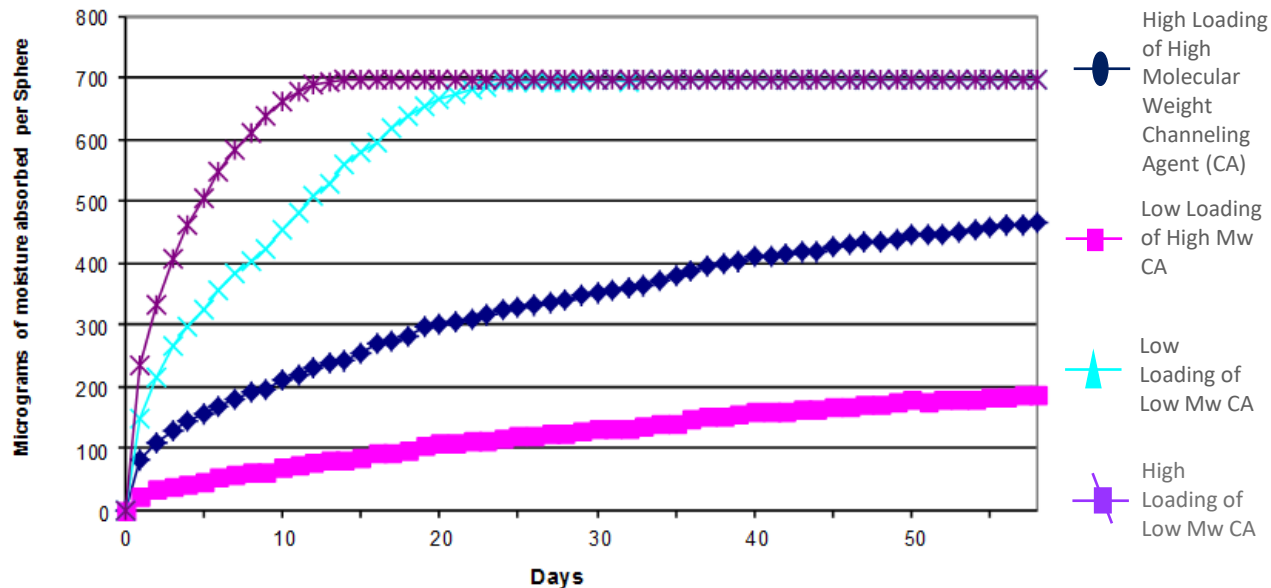


3-Phase Activ-Polymer™ material allows the **control of kinetics** based upon formulation

- Uptake rate can be increased or decreased
- Capacity can be increased or decreased

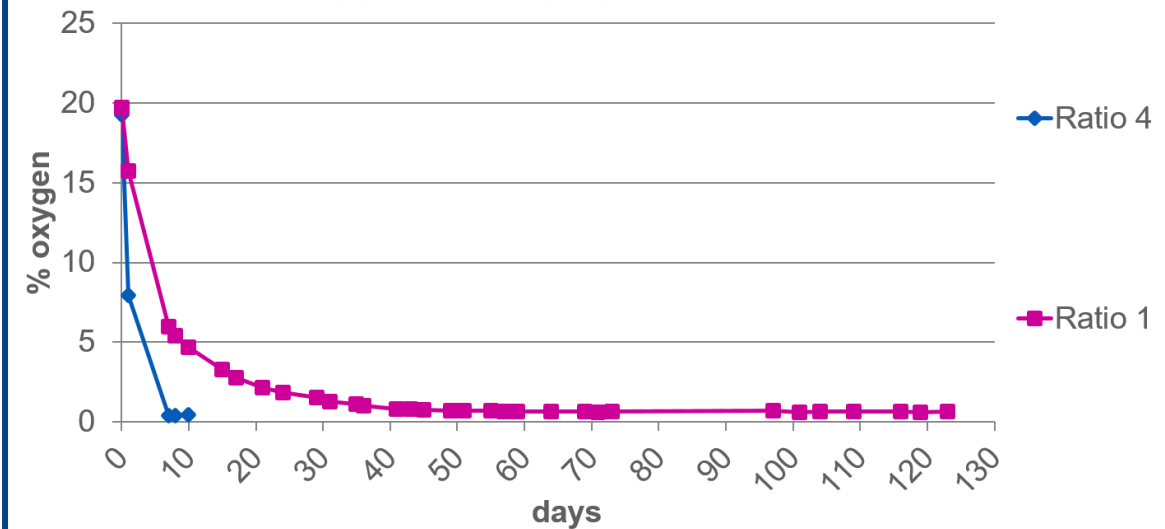
Customized Absorption Rates

ACTIV-TAB Sphere (0.00565gram) Rate of Absorption at 10% RH and 72 °F.
(Desiccant percentage and Polymer remain constant for each formula)



Oxygen Scavenging Customization

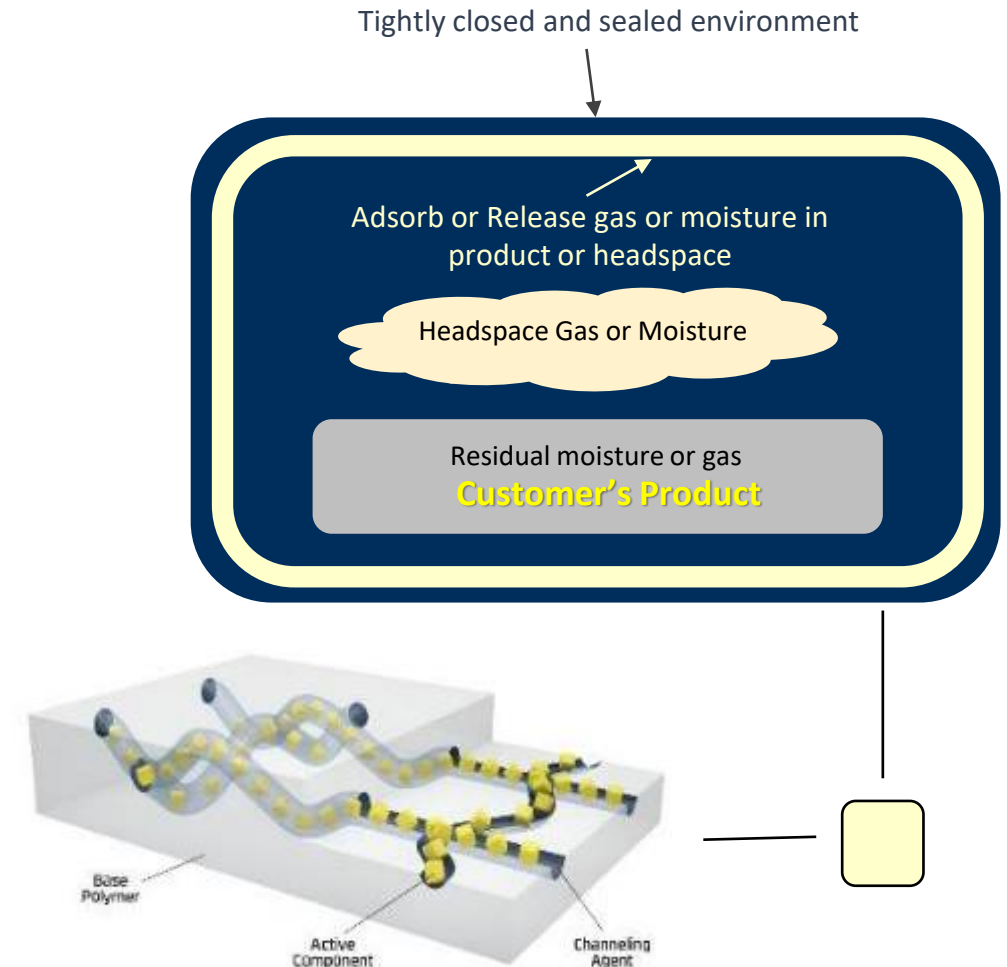
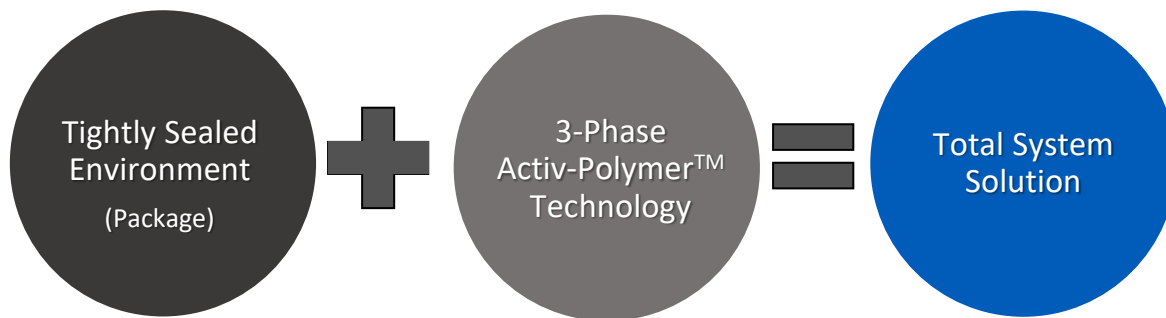
M0047
(Ratio represents =Total capacity of piece/available oxygen volume)
Oxygen absorbed per gram of film=30cc



Active Packaging – Putting Chemistry into Polymers

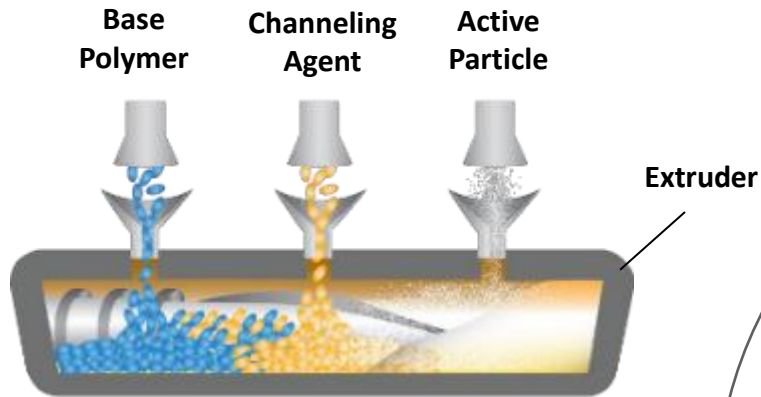
Utilizing 3-Phase Activ-Polymer™ technology requires a tightly sealed environment

- Chemistry required determined
- Gas or moisture transmission rates are reviewed
- Focus on seals associated with package
- Amount of **3-phase material** required will depend on how **tight** of an **environment** it will be placed in



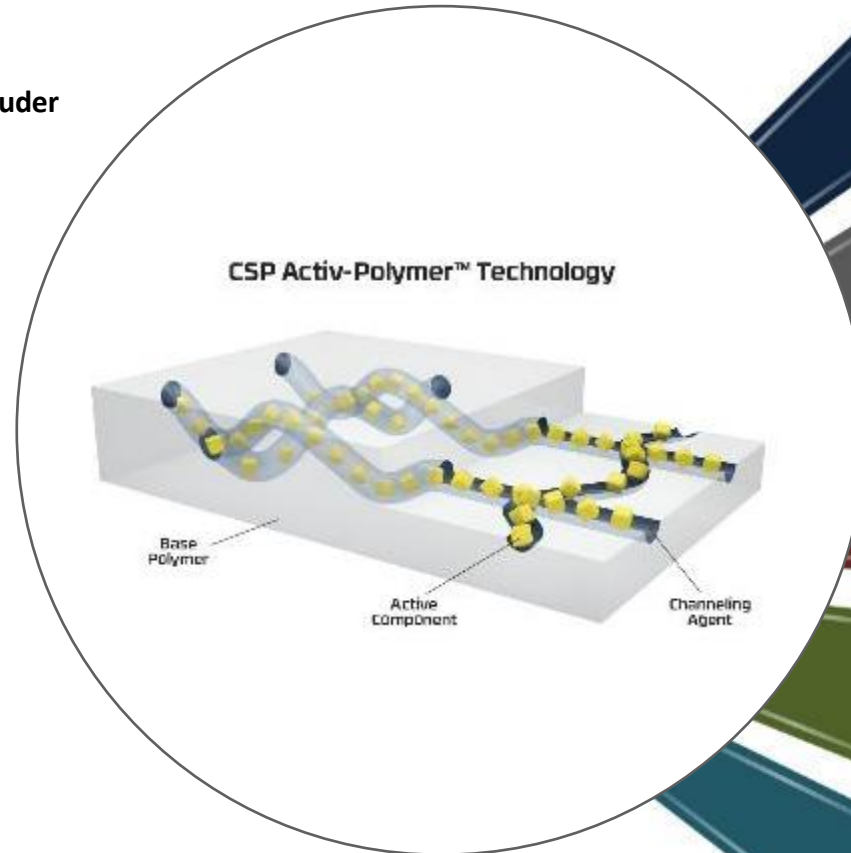
Technology & Platforms

3-Phase Activ-Polymer™ Material = Platform Material



Active Packaging Management

- Moisture Control
- Scavenging
- Antimicrobial
- Emitters
- Odor removers



Injection molding

Thermoforming

Extrusion film

Extrusion blow molding

Hot melt

Major Customer Probiotic Brands Utilizing Aptar CSP Active Packaging Solutions



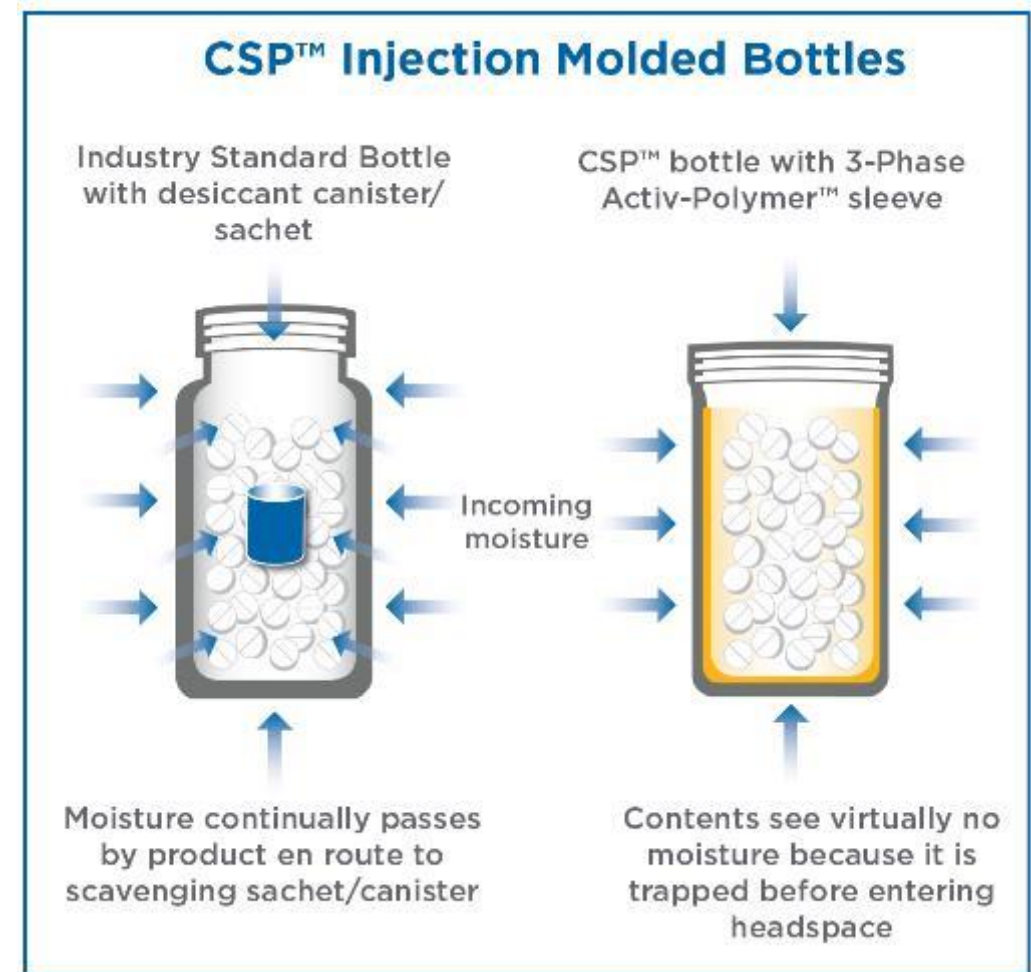
Advanced Tube Technology

- ✓ Greatest product stability
- ✓ Guaranteed potency and freshness until expiry
- ✓ Protection from moisture



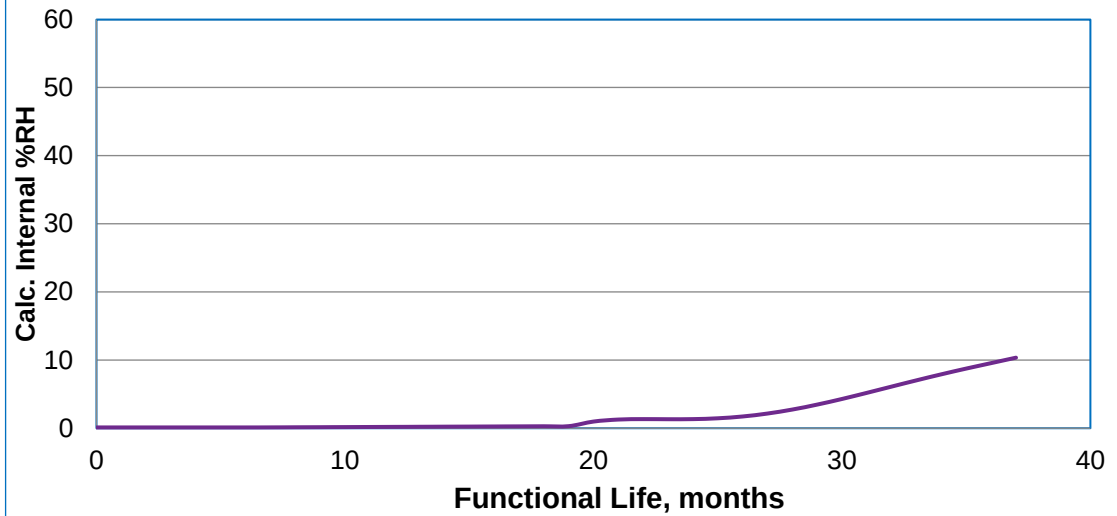
Technology Applications: Activ-Vial™ Portfolio

- **CSP™ Flip-Top Activ-Vial™** with integrated 3-Phase Activ-Polymer™ sleeve
- Patented “Close In The Mold” Technology Ensures **Moisture-Tight Seal**
- Maintains seal integrity throughout shelf life and consumer use life
- Child-Resistant/Senior-Friendly Closures



CSP™ Bottles Calculated RH Maintained 64ml and 110ml

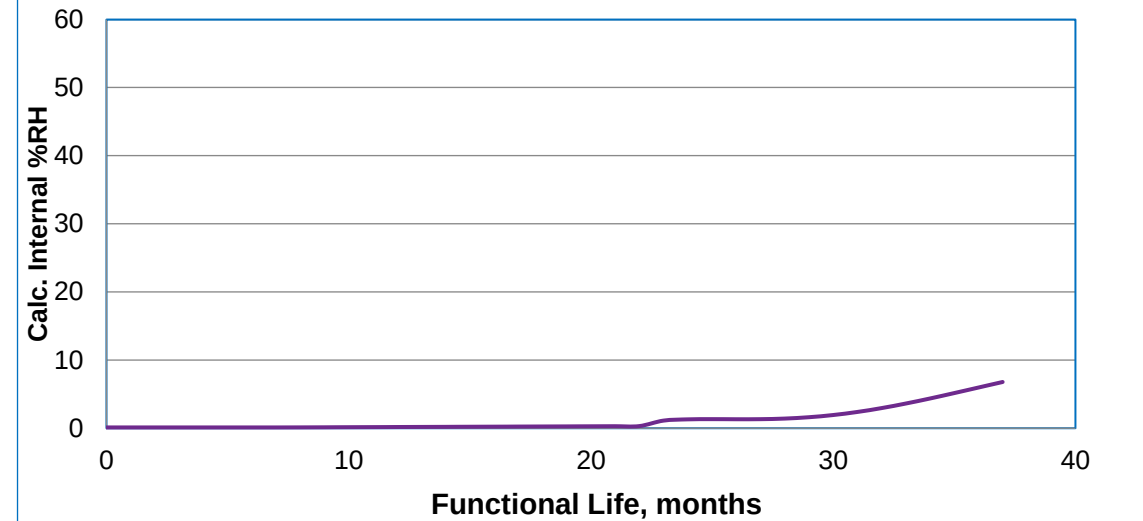
**Calculated % RH Maintained in 64mL Vial vs.
Time 25°C and 60% RH**



- Data based on empty containers. Addition of product may impact %RH
- Data based on CSP's internal testing of bottles for foil seal integrity.
- Based on minimum capacity and maximum moisture ingress per container

— 64mL Vial

**Calculated % RH Maintained in 110 mL Vial
vs. Time 25°C and 60% RH**

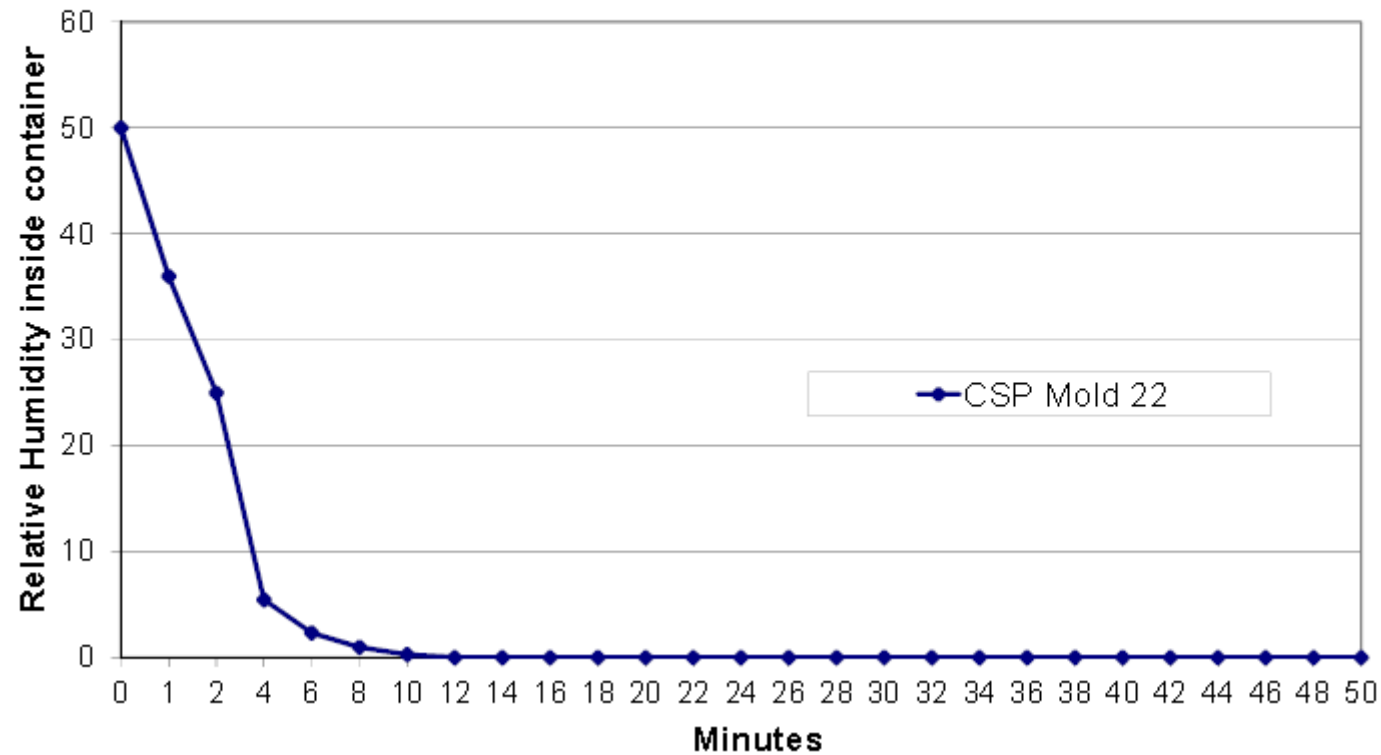


- Data based on empty containers. Addition of product may impact %RH
- Data based on CSP's internal testing of bottles for foil seal integrity.
- Based on minimum capacity and maximum moisture ingress per container

— 110mL Vial

Humidity Control with 3-Phase Activ-Polymer™ Technology

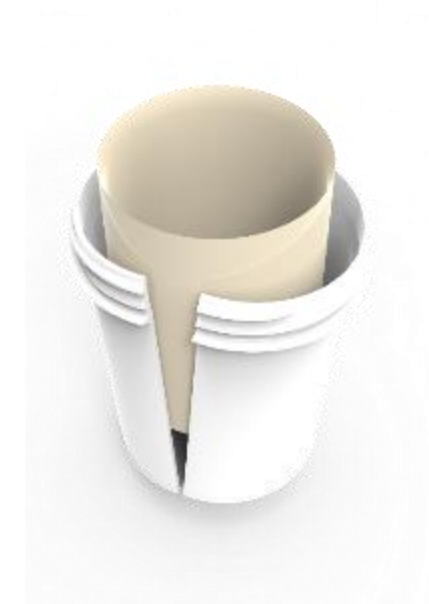
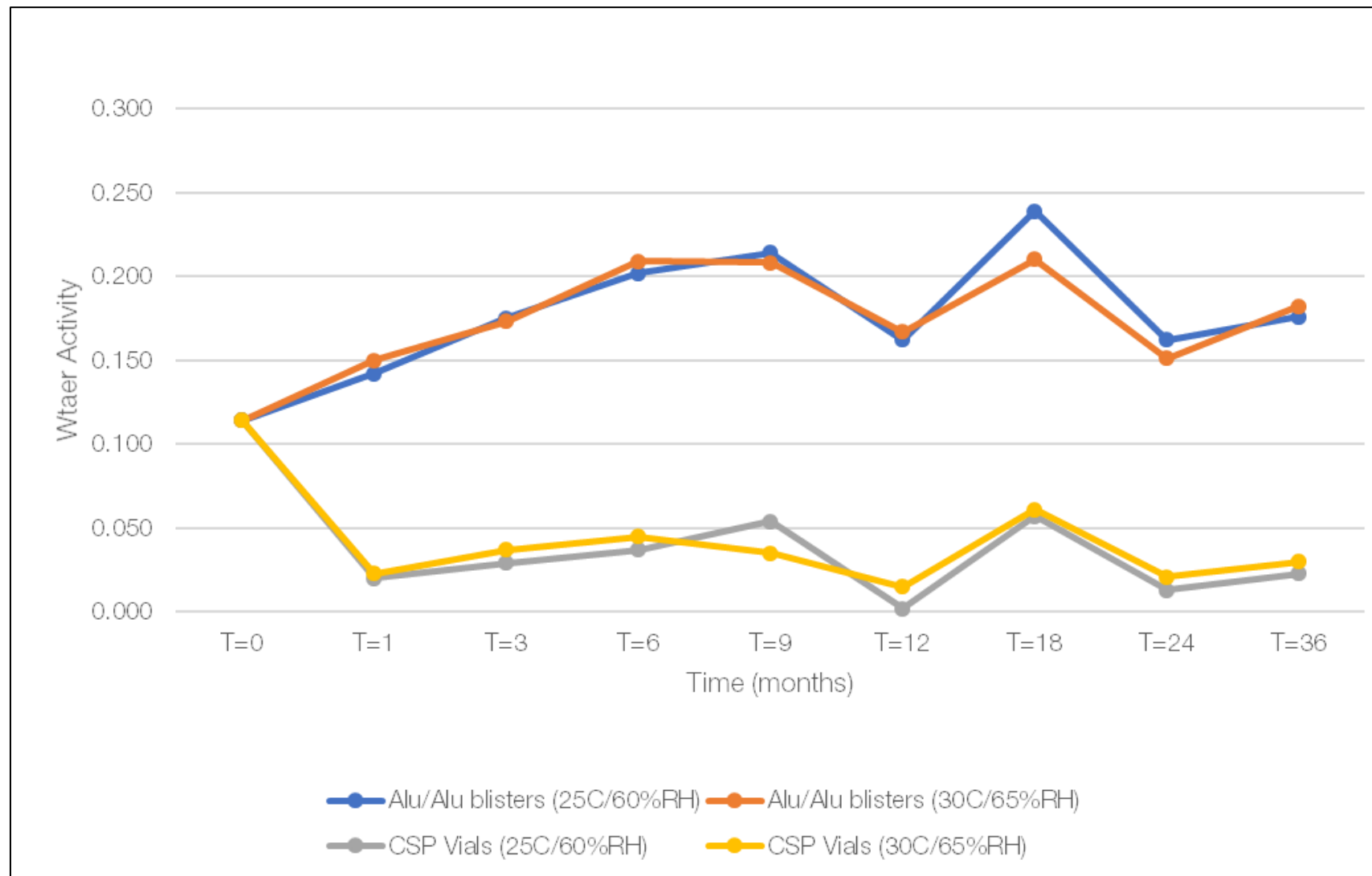
CSP Mold 22 Molecular Sieve formulation M-3003 Relative Humidity Pull Down 60 second Opening Time (80%Rh @ 72 F)



Probiotics capsules will remain dry during all use life

Probiotic Capsules – Water Activity

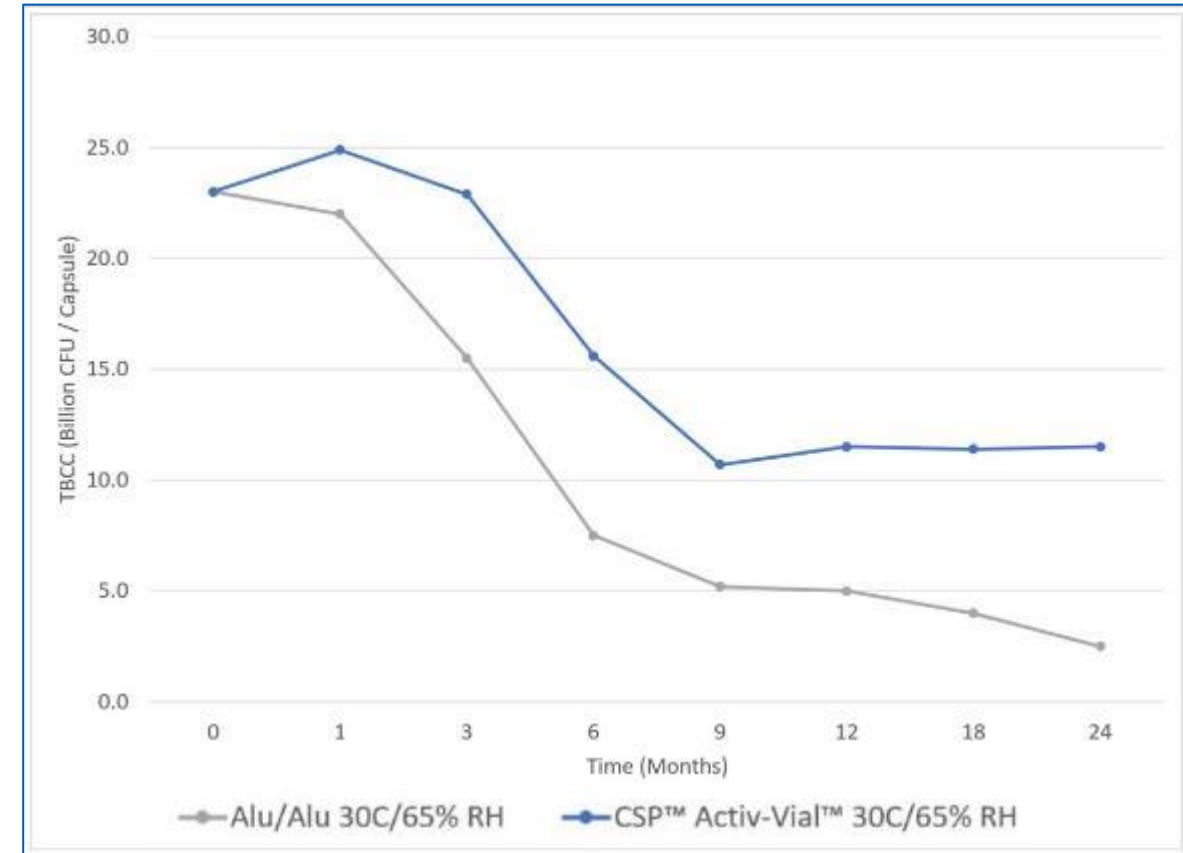
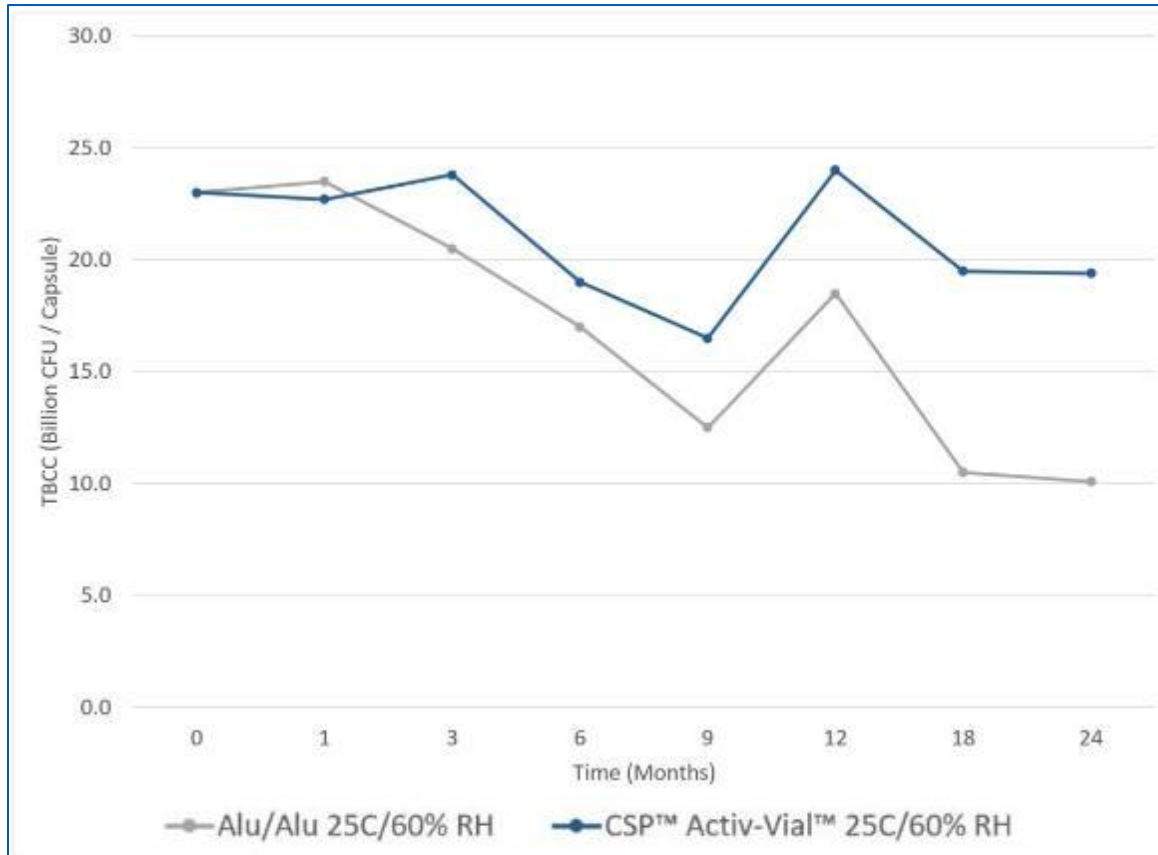
(CSP™ Activ-Vial™ vs Alu/Alu Blisters)



Study performed in partnership with UAS Labs, a leading probiotic manufacturer.

Probiotic Capsules – Strain Potency

(CSP™ Activ-Vial™ vs Alu/Alu Blisters)



Study performed in partnership with UAS Labs, a leading probiotic manufacturer.

Technology Applications: Molded Parts

- Can be an integral device component
- Can be used to adsorb **moisture, O₂, odors, etc.**
- Can maintain very tight dimensional tolerances



X-Straw: Drug Administration

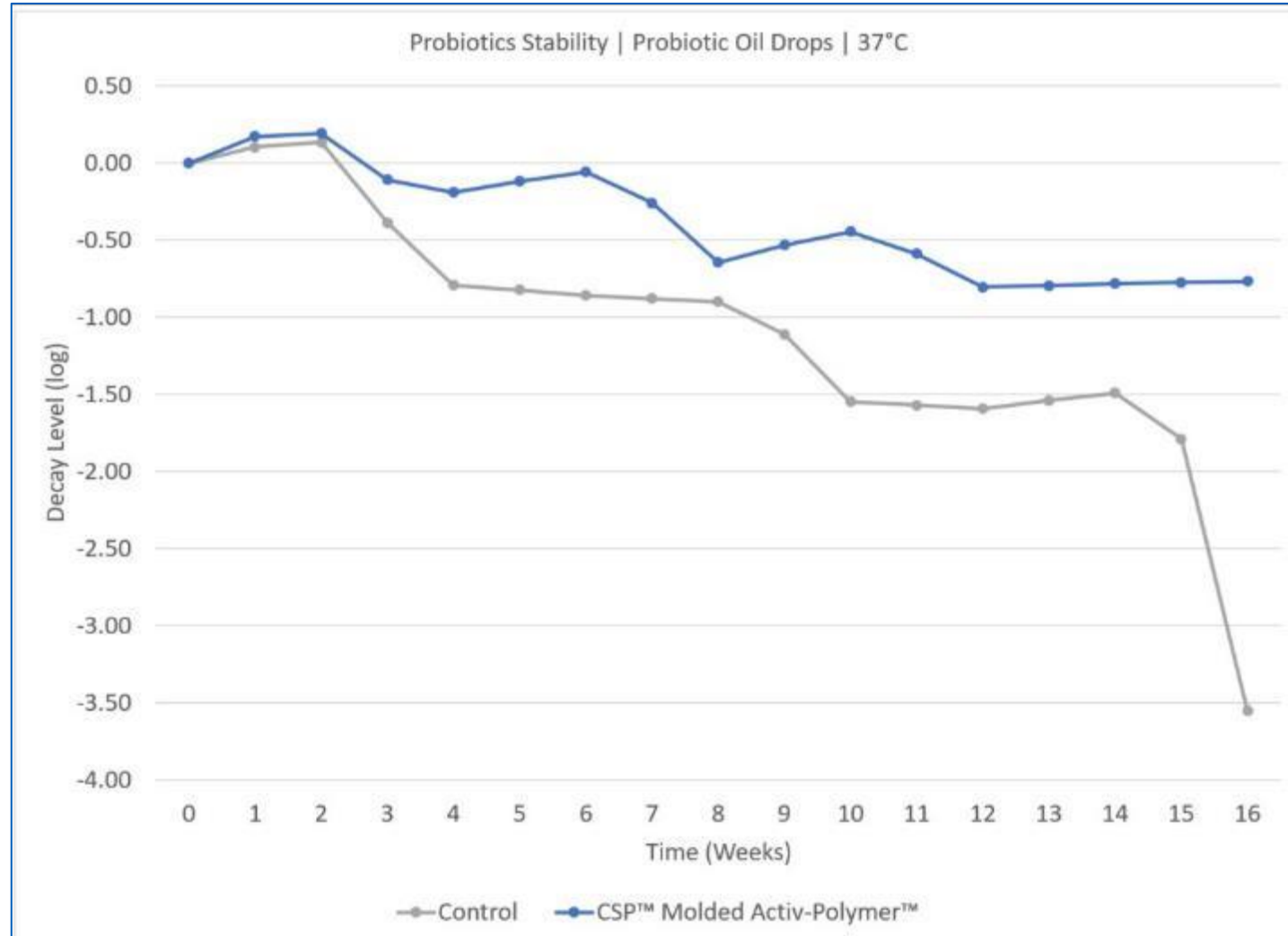


Bormioli 3 Phase
Probiotics Powder



Probiotic Oil Drops Stability

(CSP™ Molded Activ-Polymer™ vs. Control)



CSP™ Molded Activ-Polymer™ in graph uses 1 Tablet:

- 3mm thick x 8mm OD
- 0.2 gram



Data courtesy of

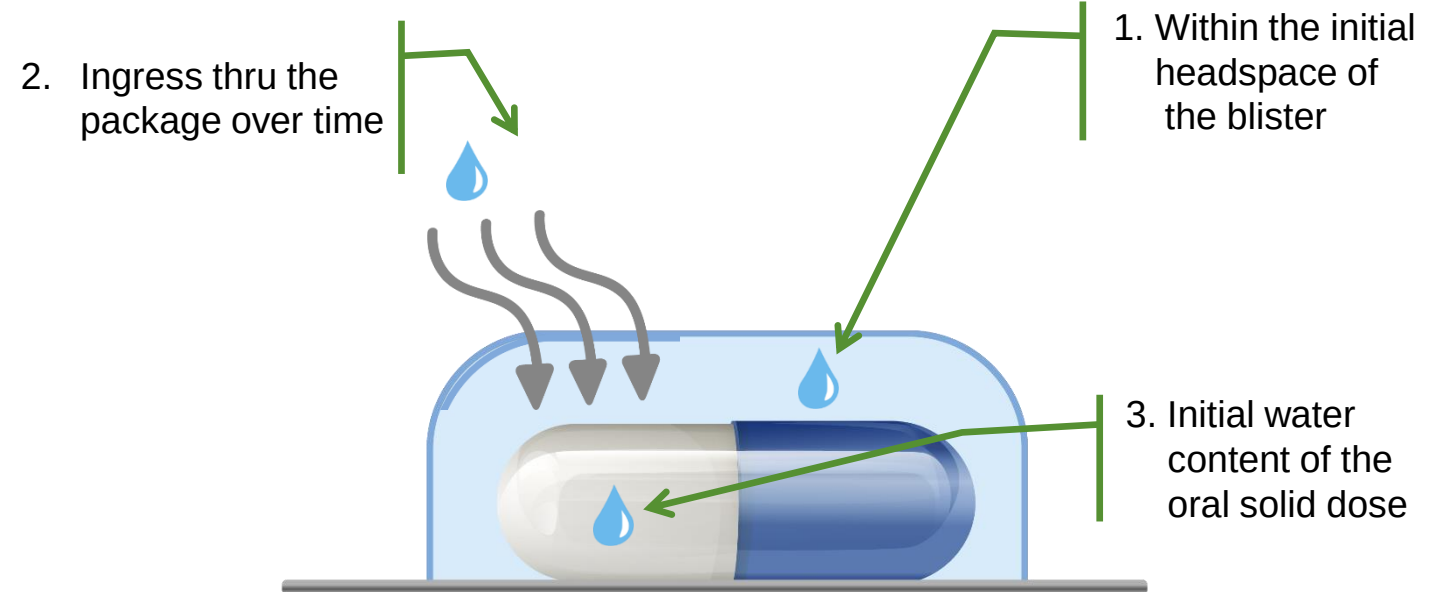


Technology Application Activ-Blister™ Solutions

- Incorporating 3-Phase Activ-Film™ into blister packaging solutions
- 3-Phase Activ-Film™ is heat staked to foil
- Protects product from moisture, oxygen, CO₂, reactive impurities and odors
- **Active headspace protection** achieved without adding extra steps (e.g. gas flush/purging, secondary packaging, or refrigeration)
- **Size reduction** → move from cold-form foils to thermoforms for a smaller blister footprint, **40-60% smaller**

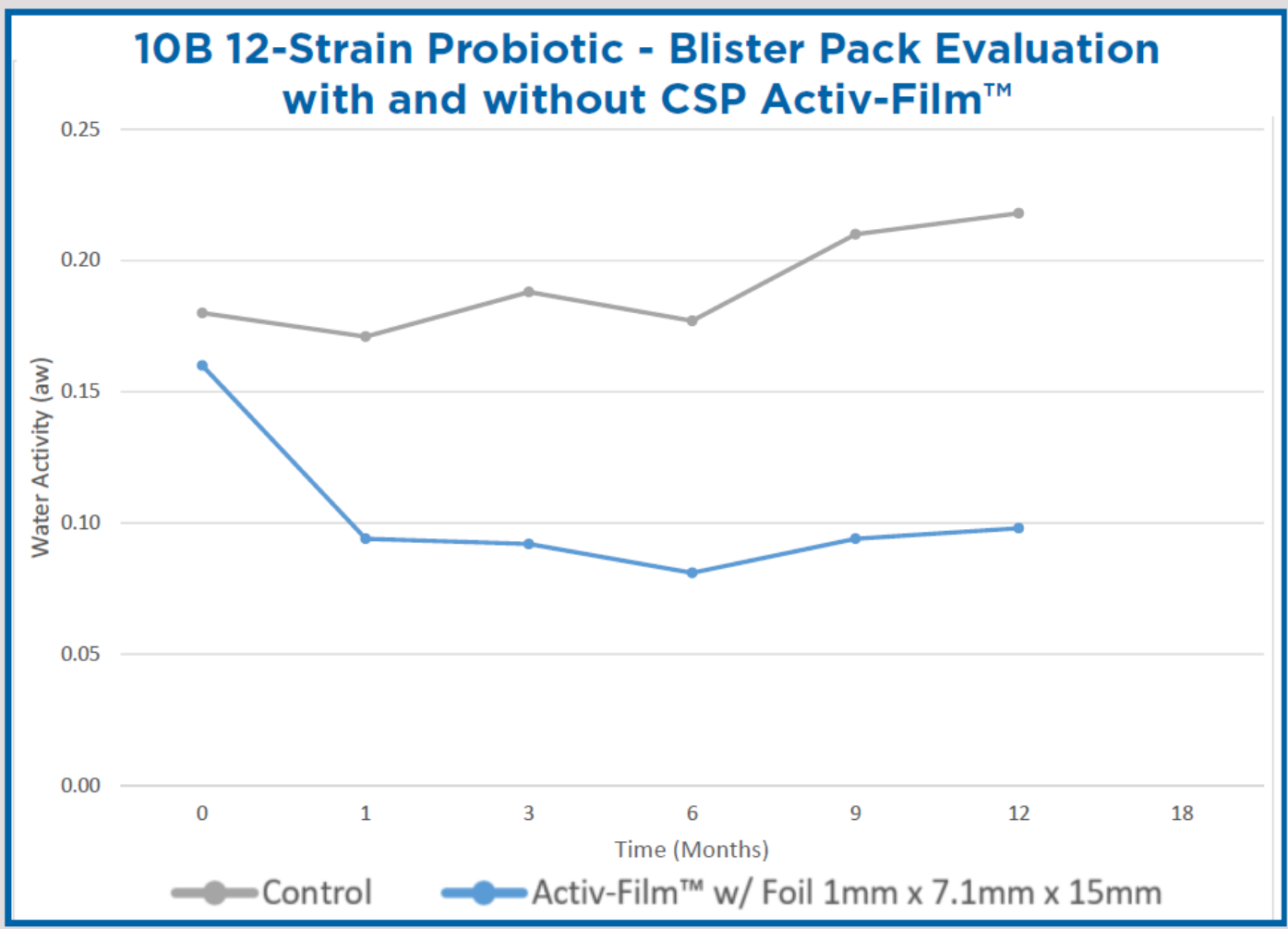


Sources of Moisture and Oxygen



Probiotic Capsule Water Activity

(Standard PVC.PvdC Blister Packaging vs. Activ-Blister™ Packaging with CSP Activ-Film™)



Storage Conditions:
22°C ± 2°C
40% ± 5% RH

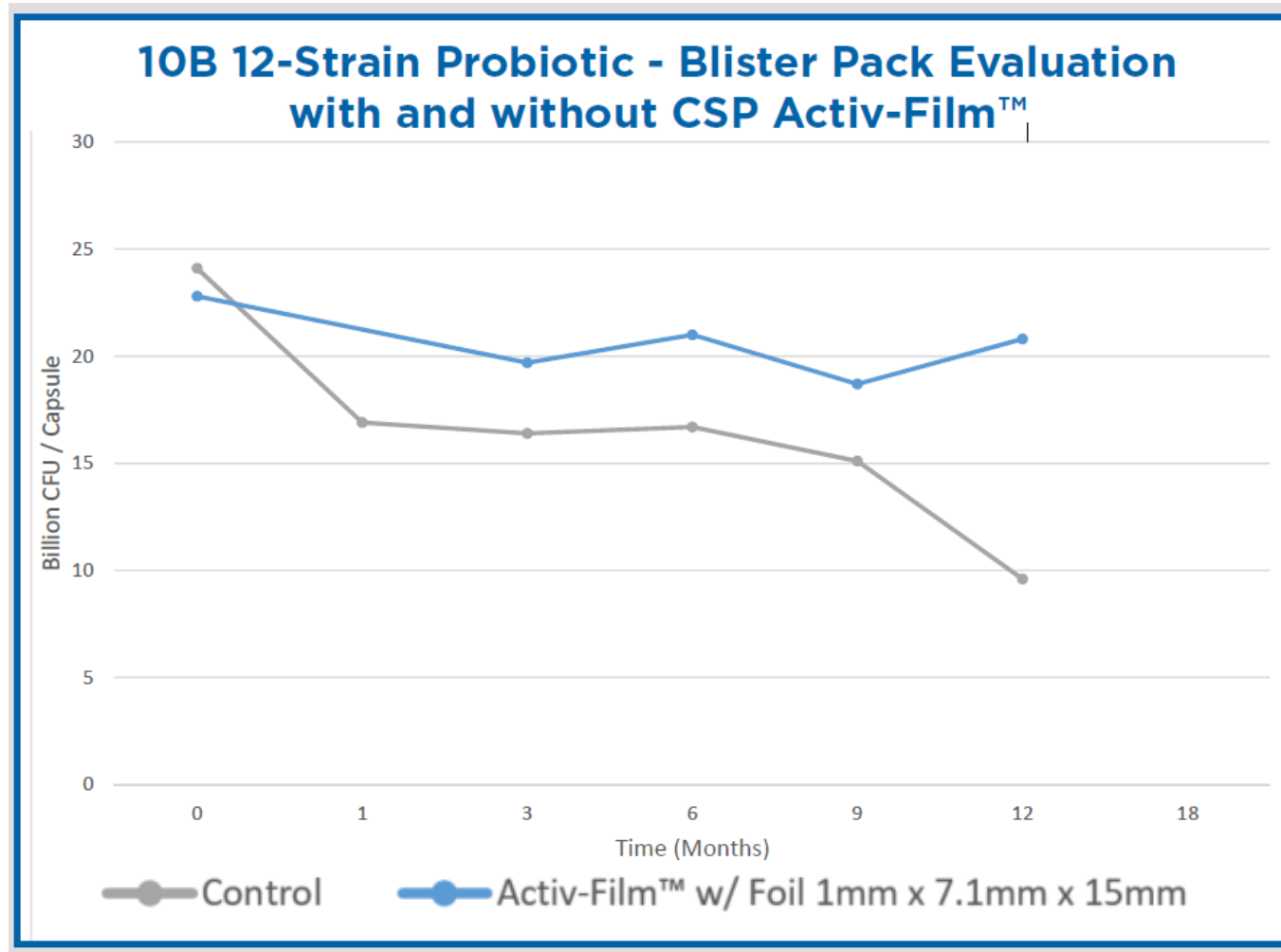


Data courtesy of



Probiotic Capsule Potency

(Standard PVC.PvdC Blister Packaging vs. Activ-Blister™ Packaging with CSP Activ-Film™)



Storage Conditions:
 $22^{\circ}\text{C} \pm 2^{\circ}\text{C}$
 $40\% \pm 5\% \text{ RH}$

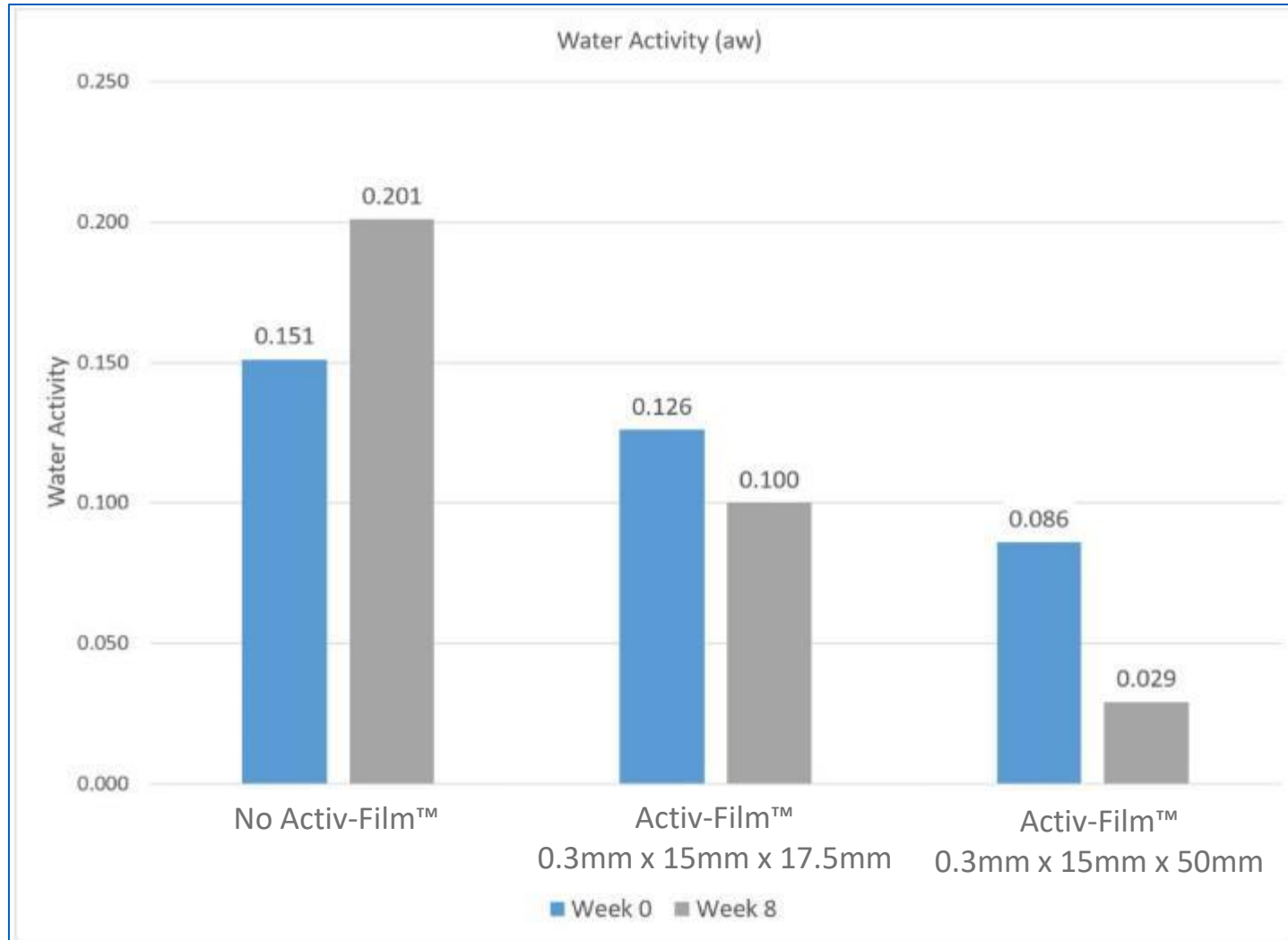


Data courtesy of



Probiotic Stick Pack Water Activity

(CSP™ Activ-Film™ vs. No Activ-Film™, Ambient Conditions)

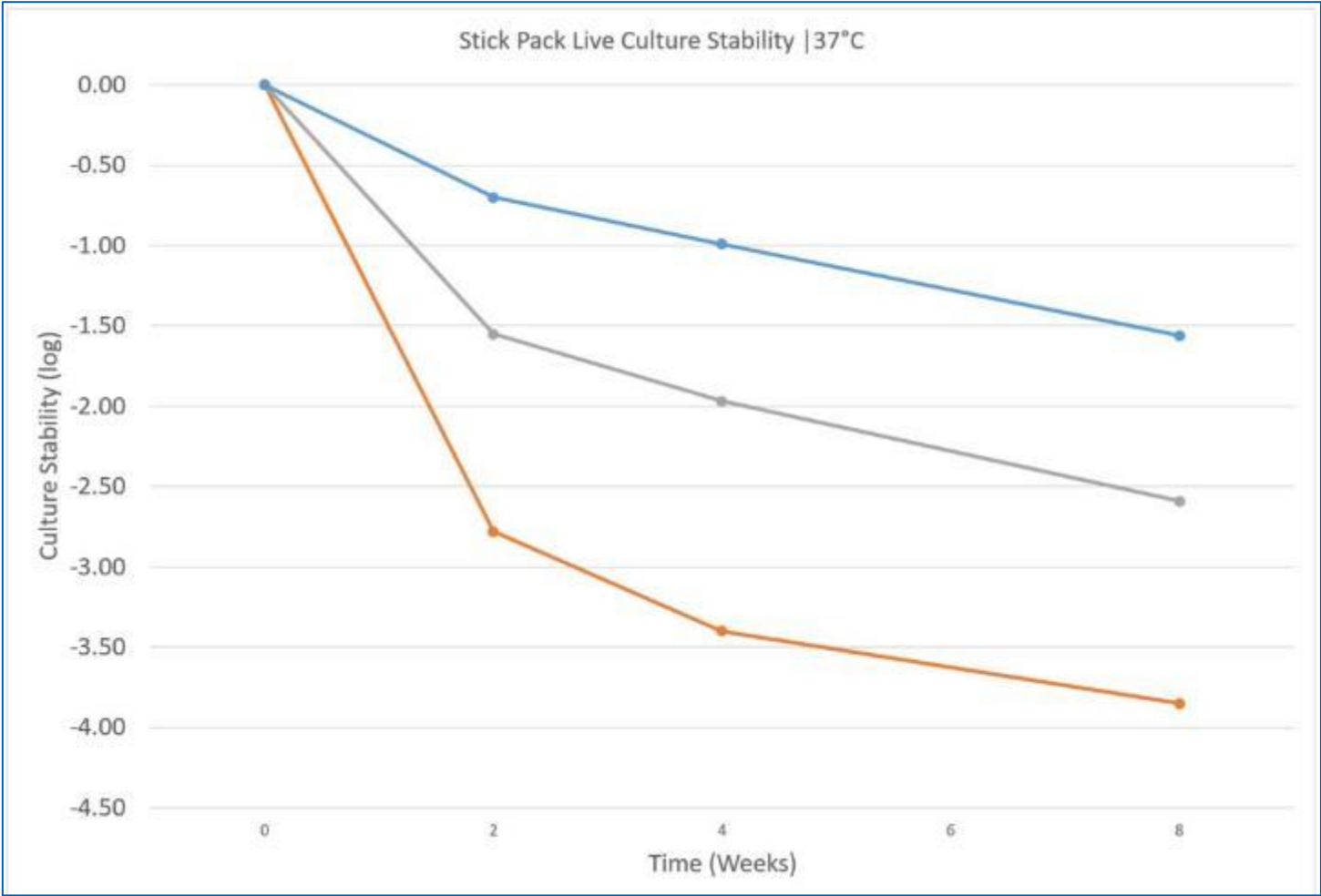


Data courtesy of



Probiotic Stick Pack Stability

(CSP™ Activ-Film™ vs. No Activ-Film™)



- No Activ-Film™
- Activ-Film™
0.3mm x 15mm x 17.5mm
- Activ-Film™
0.3mm x 15mm x 50mm

Data courtesy of



Xcelerate Development Services with Free Think Inc.

Complete solution from Stability Challenge to Production Launch

- Designed for new applications and existing packaged products

Xcelerate Development Services



Thank you for your attention!

Email: francois.bidet@aptar.com