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Discover what's naturally possible™

NATURAL FOOD PROTECTION

Capturing the Power of Clean Label Innovation

Certified B Corporation

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October 22, 2025

Plant-based products and Clean Label are tied together in consumers' minds.

Consumers look at plant-based products as falling into all three buckets of: having **minimal processing,** being **all-natural,** and containing a **short ingredient list.**

Source: 1. Consumer Perceptions of Clean Label in Plant-based Products, Kalsec 2023

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Sustainability & Food Loss / Waste

CONSUMERS FIND A VARIETY OF PLANT-BASED PROTEIN SOURCES APPEALING

68%

Of consumers are concerned about food waste

59%

Of global consumers share short shelf-life of products is the main contributor to food waste

FMCG Gurus: Addressing Food Waste and Shortages – Global Report 2023

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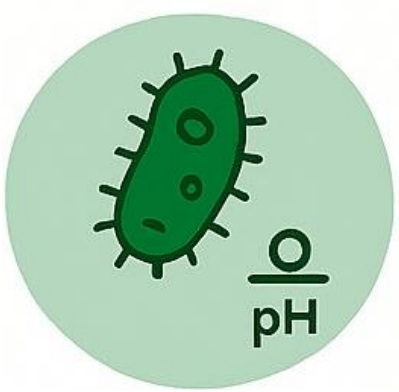
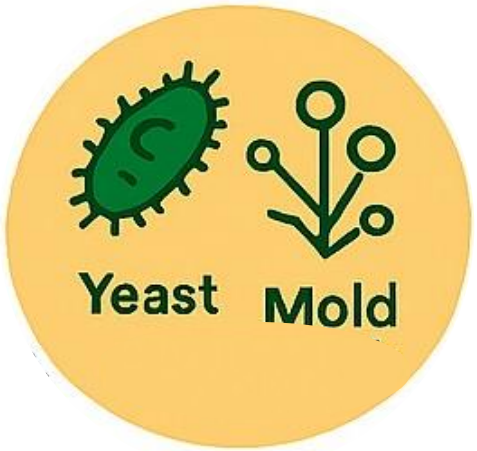
Microbial Risks in Plant-Based Products



Vulnerability to microbial growth

- High moisture
- Neutral to high pH
- Array of ingredients
- Diverse processing conditions



Common spoilage microorganisms

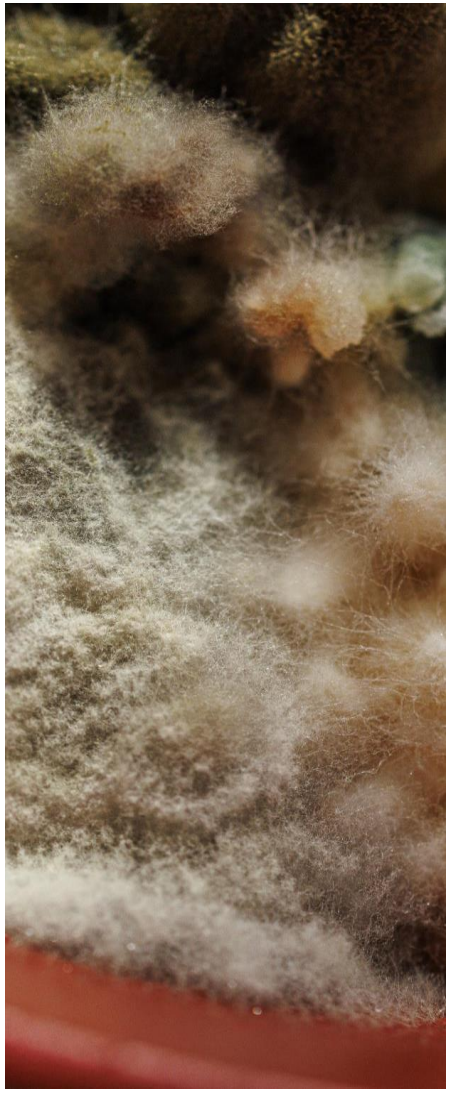
- Bacteria, yeast and mold
- Off-flavors, discoloration, texture changes, bloating, visual mold growth

Health risks from pathogens

- Pathogens like *Listeria* and *Salmonella* pose serious health risks especially under refrigerated conditions

Impact on food safety and shelf-life

- Rapid microbial proliferation reduces shelf-life and increases food waste necessitating effective safety measures



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“Designing for Freshness: Setting Realistic Shelf-Life Goals in Plant-Based Innovation”

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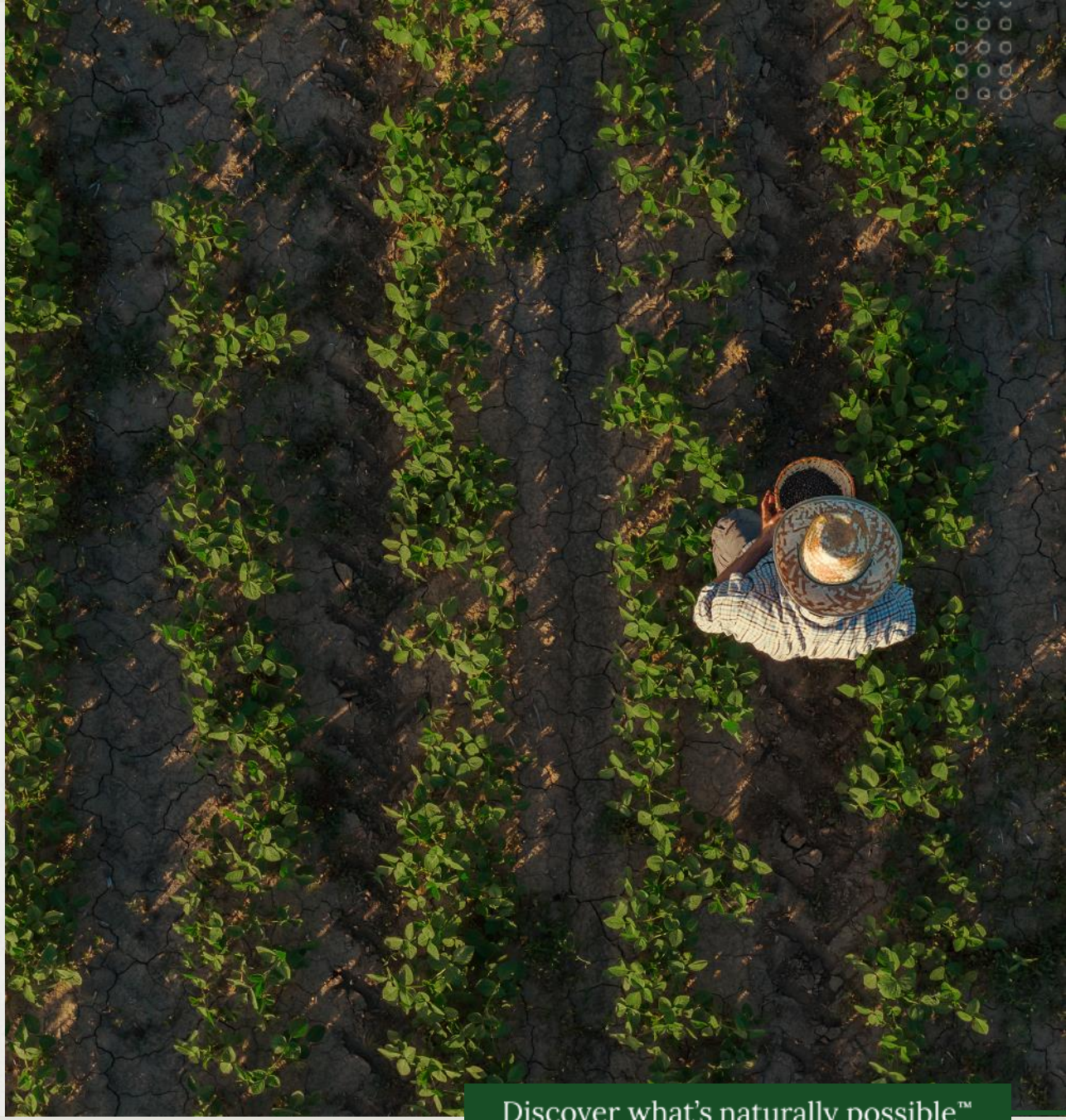

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CASE STUDY

Shelf-life of Plant-based Meat at Refrigerated Conditions

Objectives: to determine the shelf life and identify spoilage microorganisms in plant-based meat

- Plant-based proteins were prepared (fresh, uncooked)
- pH= 6.2, Aw > 0.9

Samples were vacuum packaged & stored at 4°C

PCA (total plate count) & MRS (Lactic acid bacteria) plates

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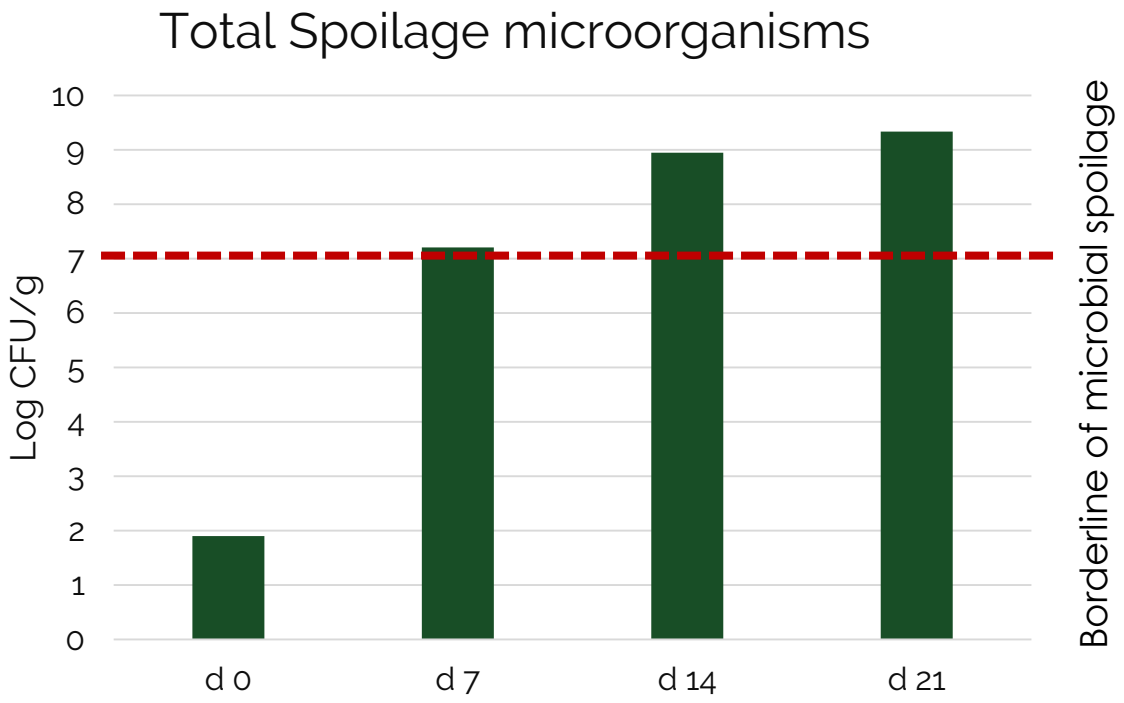
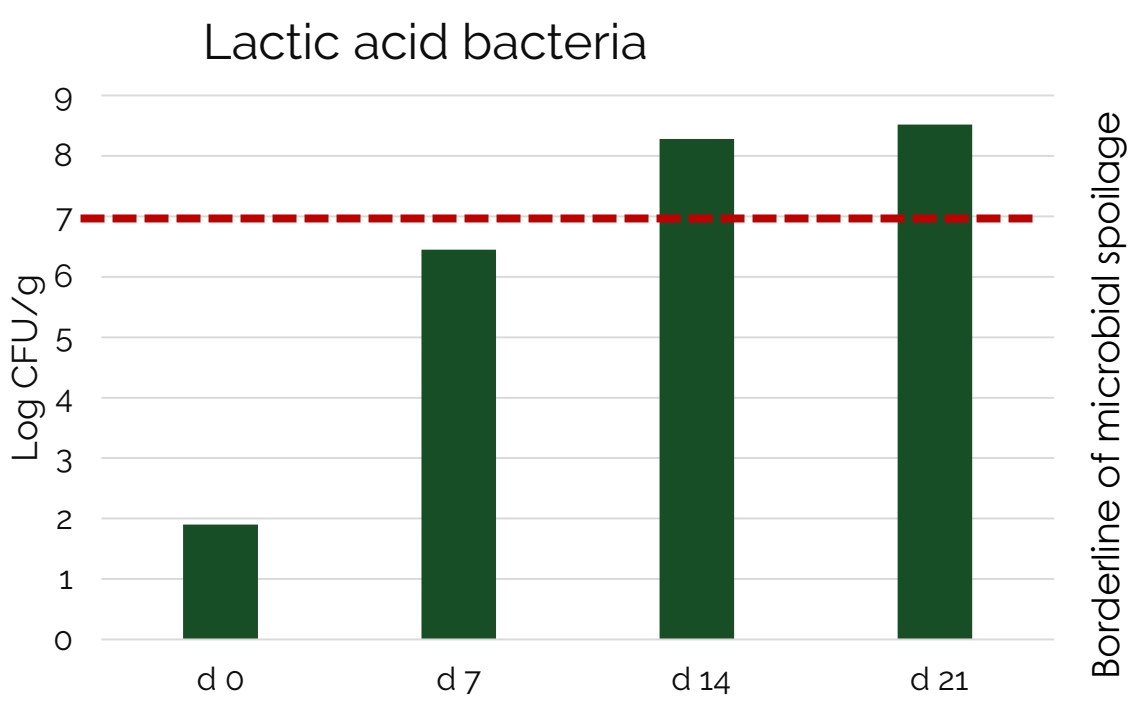
Identification of spoilage microorganisms in plant-based meat





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Role of Natural Food Protection

ENSURING YOUR FOOD LOOKS BETTER, TASTES BETTER AND LASTS LONGER, NATURALLY

Increased Shelf Life

Extend shelf life by inhibiting microbial spoilage

Quality Longevity

Help to maintain quality by preventing discoloration, off flavors and other signs of food degradation.

Improved Safety

Prevent growth of harmful microorganisms that can cause foodborne illness, such as *Listeria* and *Salmonella.*

Reduce Waste

By preventing spoilage and extending shelf life, **antimicrobials help reduce food waste.** Saving money for manufactures, retailers and consumers alike.

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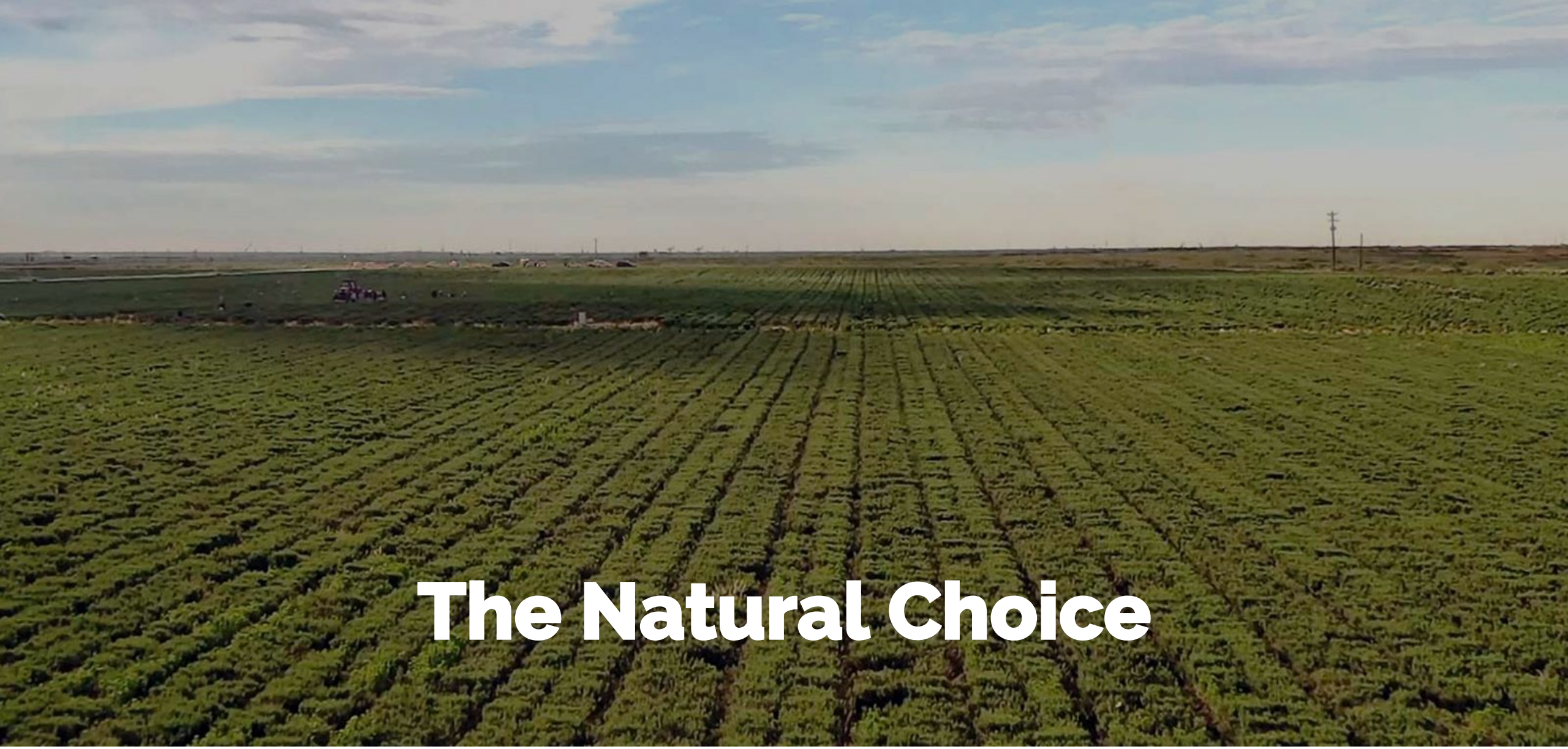

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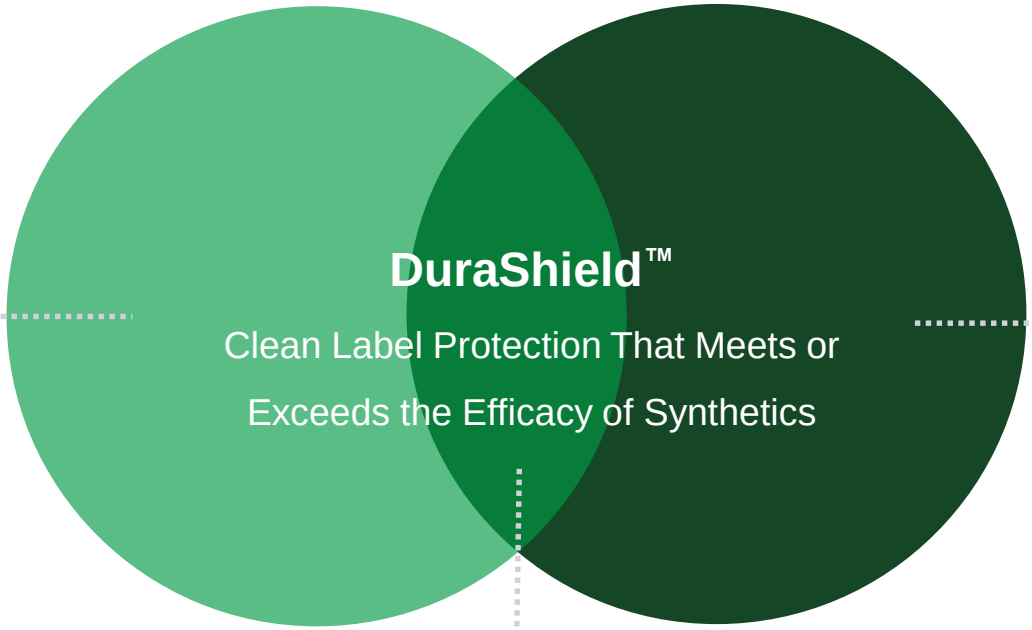
DuraShield™ Natural Food Protection Blends

NATURAL ANTIOXIDANTS

Rosemary Extract



NATURAL ANTIMICROBIALS

Cultured Dextrose

Buffered Vinegar

SYNERGISTIC EFFECT 1+1>2

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Specific statements and examples of applications may not apply in all geographical regions. Usage and labeling and associated claims may vary based on governmental regulations.

DuraShield™ for Plant-Based Meat

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Spoilage control

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CASE STUDY

Spoilage Microorganism Inhibition In Pea-Based Meat Alternative

DuraShield NP: Cultured Dextrose + Rosemary

Objectives: To determine the efficacy of DuraShield NP Food Protection Blend against spoilage microorganisms in pea-based protein in refrigerated storage conditions.

Material & Methods

- Treatments: (in duplicate)
  - Untreated growth control
  - 1% DuraShield NP (Cultured Dextrose + Rosemary)
- Pea-based protein patties were vacuum packaged.
- Stored at 4°-7° C for 33 days.
- Aerobic plate counts and lactic acid bacteria counts were measured using PCA and MRS plates, respectively

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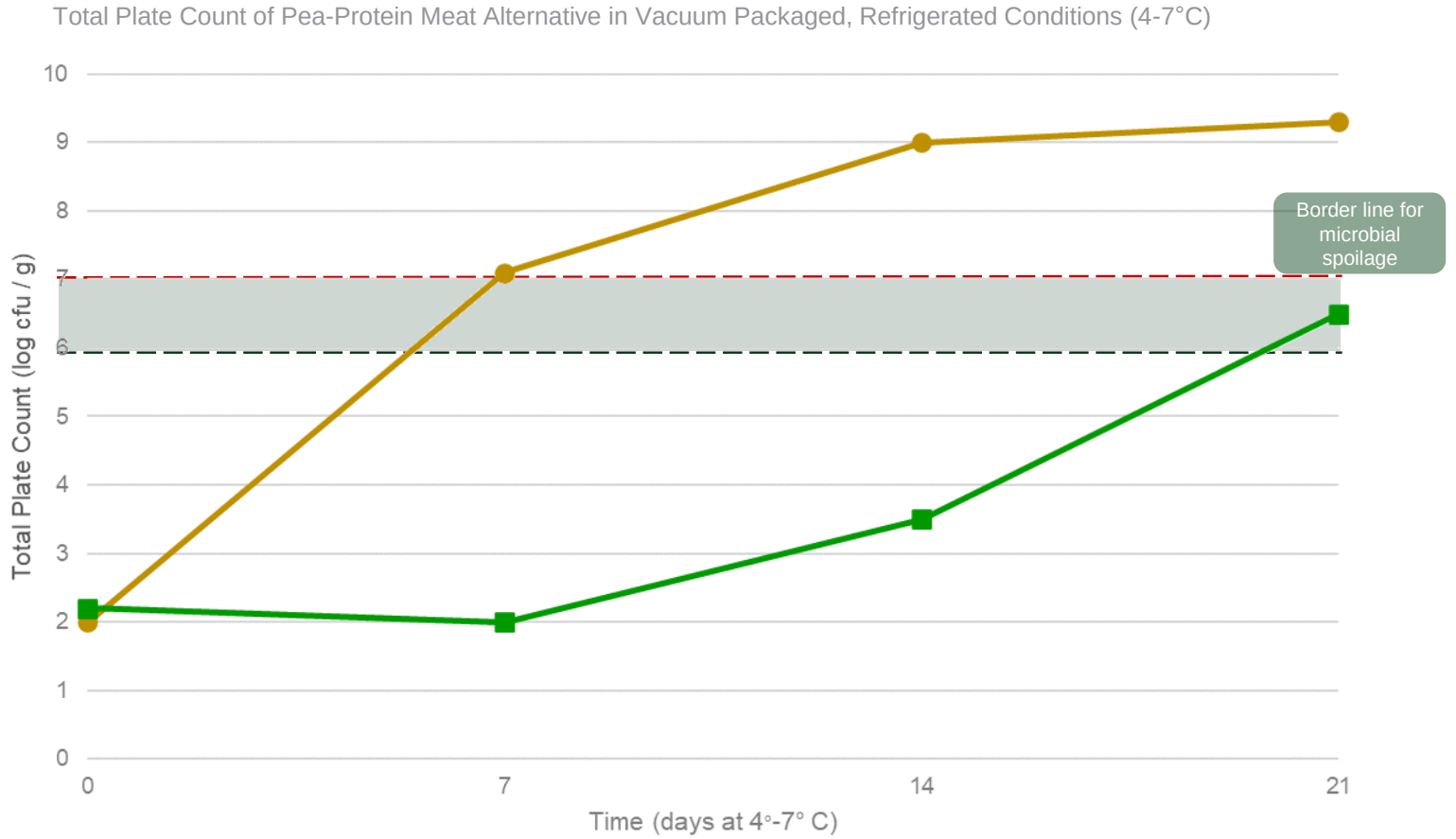
KALSEC RESULTS:

DuraShield NP inhibited the growth of aerobic spoilage bacteria for 21 days, extending shelf-life by an additional 2 weeks.

DuraShield Extends Shelf-Life & Protects Against Spoilage



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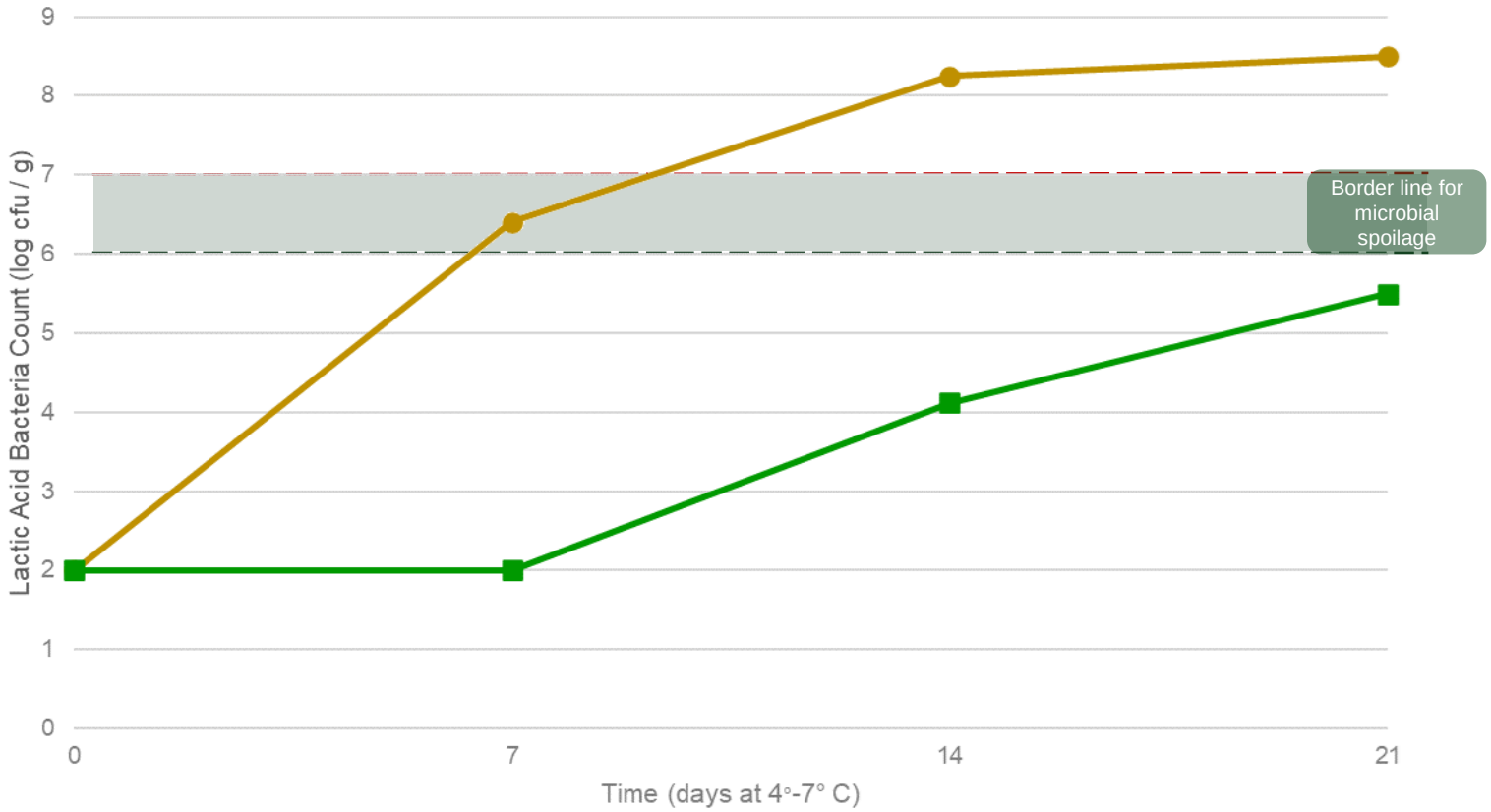
KALSEC RESULTS:

DuraShield outperformed untreated control pea-protein patty, adding 2 weeks additional shelf-life.

DuraShield NP Protects from Lactic Acid Bacteria

Lactic Acid Bacteria Count of Pea-Protein Meat Alternative in Vacuum Packaged, Refrigerated Conditions (4-7°C)



DATA LEGEND

- Untreated Control
- 1% DuraShield NP (Cultured Dextrose: + Rosemary)

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Microbiome Derived Spoilage Identification

Patty homogenates

DNA extraction

ZymoBIOMICS DNA Miniprep Kit

Amplification of V4 hypervariable region of 16S rRNA gene

Sequencing using Illumina MiSeq paired end 2X250 bp technology

Clustering and filtration of sequences using QIIME workflow

OTUs determination at 97% sequence similarity

Downstream analysis with R version 3.3

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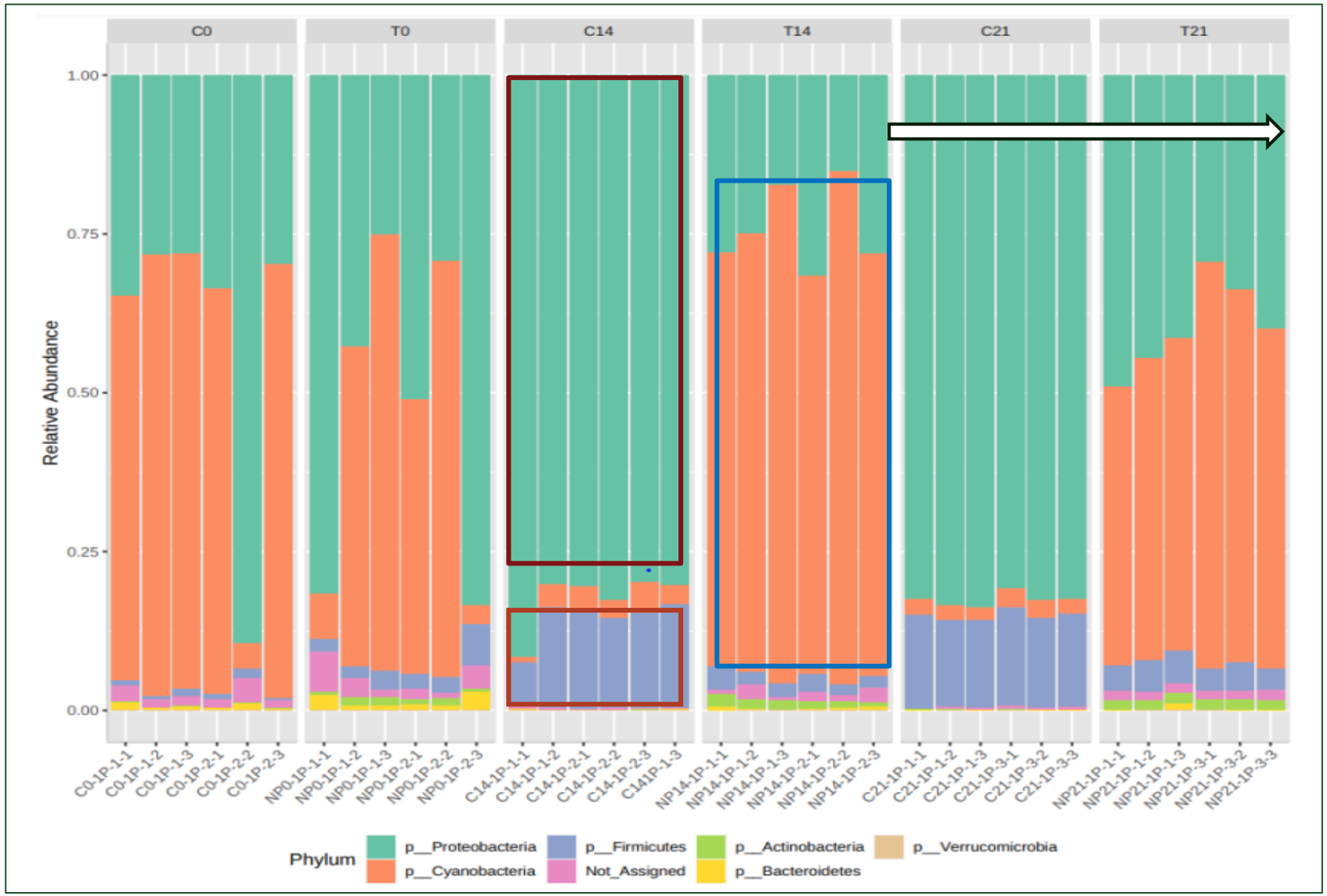
DuraShield NP suppresses the growth of key spoilage formers in plant-based meat



Why DuraShield NP?

- DuraShield inhibited the growth of Proteobacteria and Firmicutes
- *Pseudomonas*, *Lactobacillus*, *Carnobacterium* and *Serratia* are common spoilage bacteria under these groups

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Pathogen control

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CASE STUDY

Inhibiting *Listeria* Growth in Plant-Based Meat Alternatives

Objectives: To evaluate the effectiveness of DuraShield NP in inhibiting *Listeria* in refrigerated plant-based meat.

DuraShield NP: Cultured Dextrose + Rosemary

Material & Methods

- Treatments: (in duplicate)
  - Untreated Growth Control
  - 1% DuraShield NP

- On Day 0, frozen crumbles were thawed, inoculated with a cocktail of 3 strains of *Listeria monocytogenes* (3.5 log CFU/g), vacuum-packed, and stored in retail style refrigerator at 4-7°C for 105 days.
- Selective media: *Listeria* selective agar incubated at 37 °C

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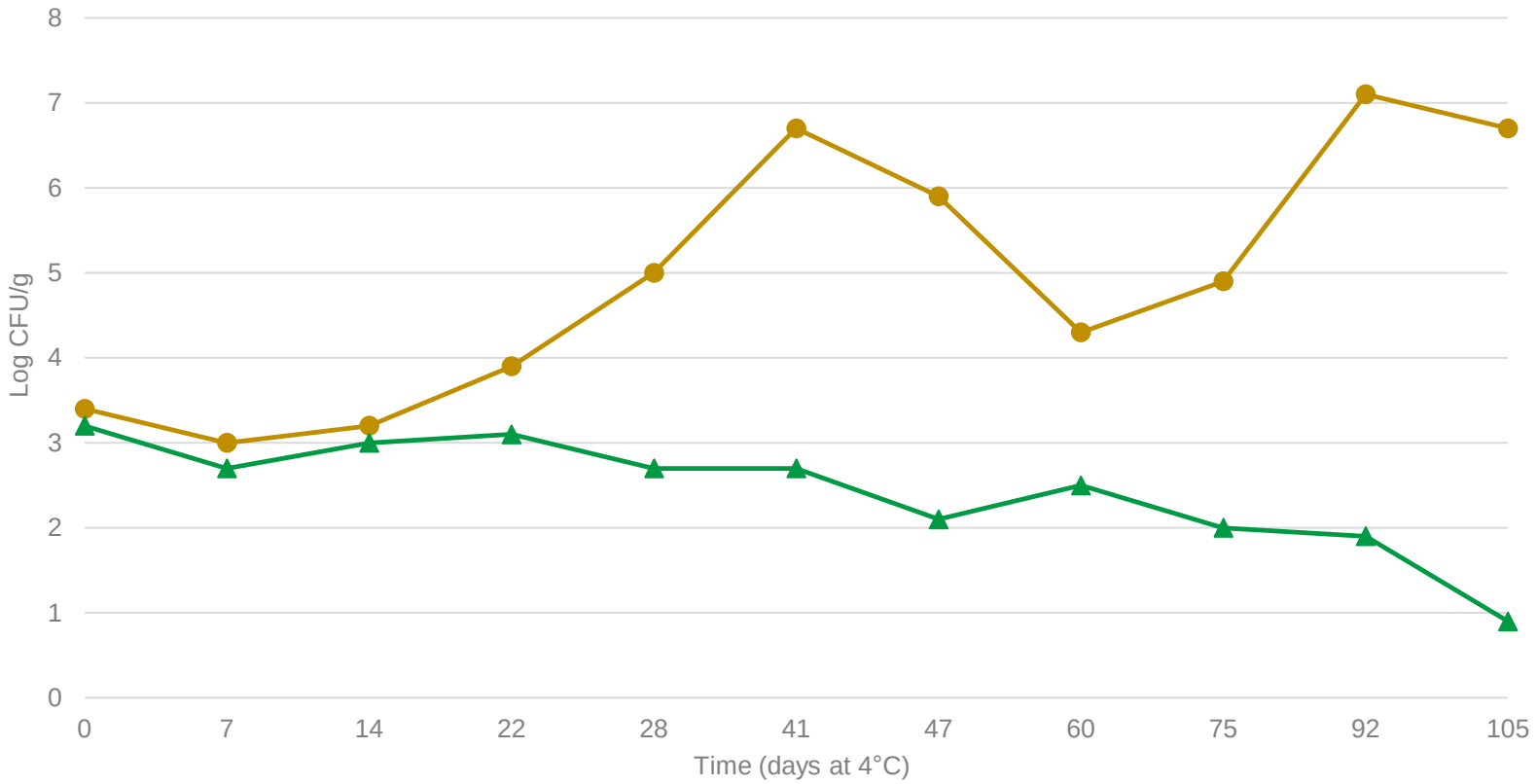
KALSEC RESULTS:

DuraShield NP effectively inhibited *Listeria monocytogenes* growth in plant-based meat, maintaining low levels for 105 days compared to untreated samples.

Growth inhibition of *Listeria monocytogenes* in plant-based meat in vacuum packaging (4°C)



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Summary of Plant-based Meat Study

SCIENTIFICALLY PROVEN EFFICACY, SENSORY VERIFIED PERFORMANCE

Superior Natural Protection

DuraShield provides **natural shelf-life extension** in plant-based meat.

Proven Protection

Kalsec clean label antimicrobial provides **proven protection against *Listeria*** at refrigerated conditions.

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Scientifically Proven & Sensory Verified Performance

IN A FULL RANGE OF PLANT-BASED FOODS

ANTIMICROBIALS

Soy & Pea-Based Meat Alternatives

Vegan Cheese (Starch & Nut Based)

Sauces, Dips & Dressings

Spreads

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Strategic Implications for Product Developers

ENSURING YOUR FOOD LOOKS BETTER, TASTES BETTER AND LASTS LONGER, NATURALLY

Clean Label Antimicrobial Integration

Integrating natural antimicrobial solutions is **essential for safety** and aligns with **consumer demand** for clean label products.

Microbiome Analysis Benefits

Microbiome analysis helps understand spoilage mechanisms and **supports targeted food safety interventions**.

Brand Differentiation

Using clean label antimicrobial technologies enhances **brand value**.

Reduce Waste

Using clean label antimicrobial technologies **reduces waste** and **promotes sustainability.**

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Why Kalsec for Plant-based?

- Offer a natural and clean-label portfolio
- Product versatility in formats and delivery systems
- Cross-functional team of experts

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Stay in touch!

If you have questions or want samples, we are happy to help!

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Thank you

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