



Strategies to Minimize Health Risks to Animals from Food Oxidation

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Agenda

- Introduction
- Understanding Oxidation Risks & Impact on Animal Health
- Managing impact of Oxidation on Quality
- Marketing and Research Opportunities





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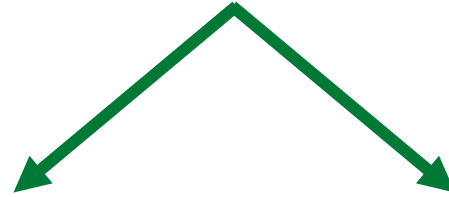
- **32 years experience with Kemin focused on Petfood and Rendering**
- **Primary focus on Antioxidants and Food Safety**
- **10 years Quality, R&D, and CLS experience**
- **10 years Technical Service experience**
- **12 years Antioxidant & Food Safety Product Management experience**



Understanding Oxidation Risks & Impact on Animal Health



Managing Raw Material Risks



Microbial Degradation

Free Fatty Acids (FFA)

Biogenic Amines (BA)

Lipid Oxidation

antioxidant required to preserve quality and meet shelf-life requirements

Impact of Oxidative Damage

- Product **quality** is reduced as oxidation increases → reduced **shelf-life** → **nutritional losses** → negative **color** and **texture** effects → reduced **palatability** and **decline in nutritive value**

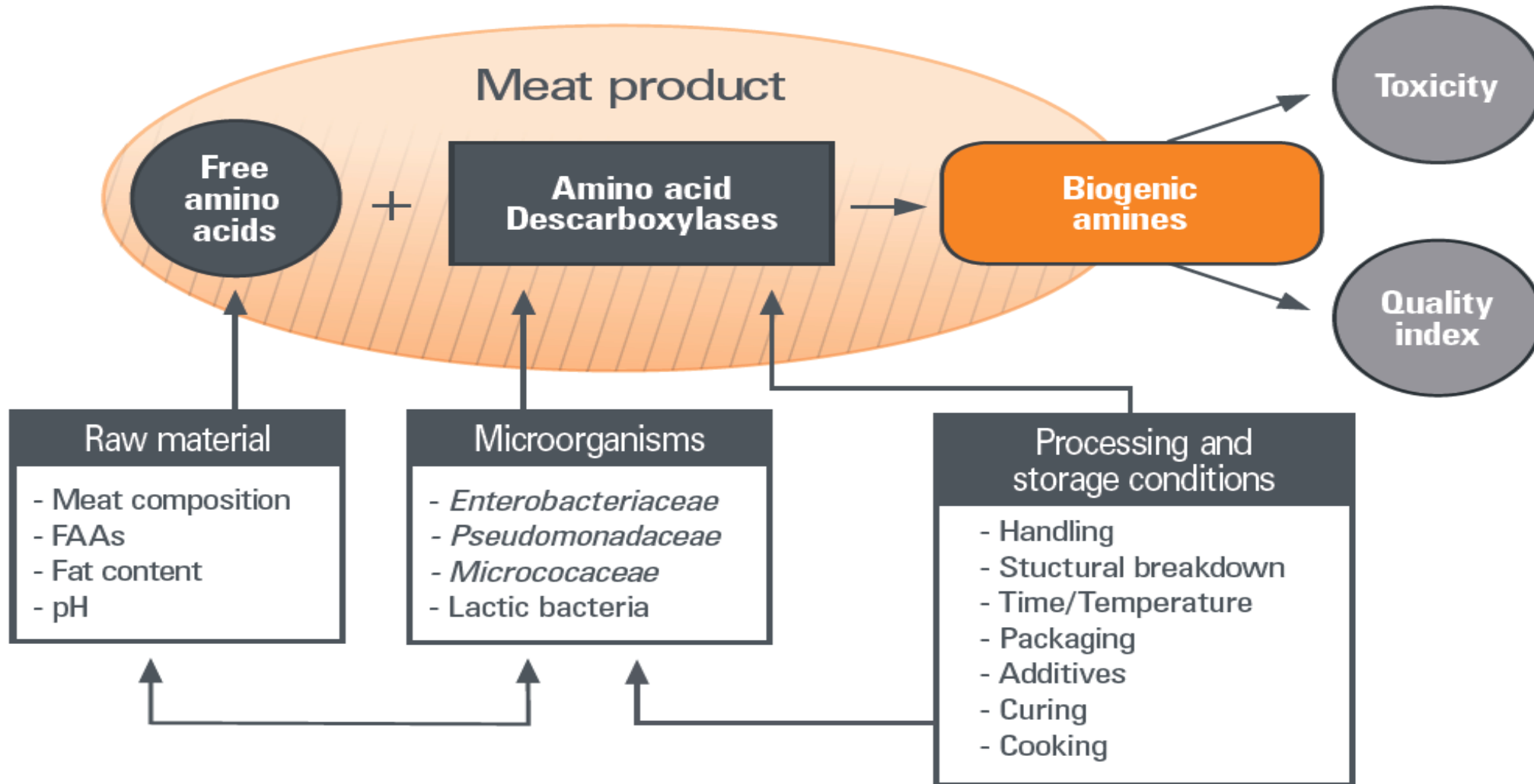
Impact of Microbial Hazards

- BA have **potential for toxicity** at high levels → **negative impact on physiological functions** → **reduced palatability**
- **FFA can increase oxidative risk** → Impact on Palatability → Impact on rendering plant operations



Biogenic Amines

The Process of Biogenic Amine Production¹



Sources of Oxidation

- Rendering raw materials
- Fats and oils
- Animal by-product meals
- Fresh/frozen animal tissues
- Animal hydrolysates
- Ingredients containing vegetable oils
- Fat soluble vitamins

Petfood Industry Ingredient Trends

Diets higher in unsaturated fats

Natural, organic, holistic

Vegetable oil substitution for animal fats

Algal meals and flax as Omega 3 sources

Corn alternatives (oat groats, flax, soybean, brown rice, other small grains, etc.)

Fresh meats and novel protein sources

Trends support higher oxidative risks

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Consequences of Oxidation

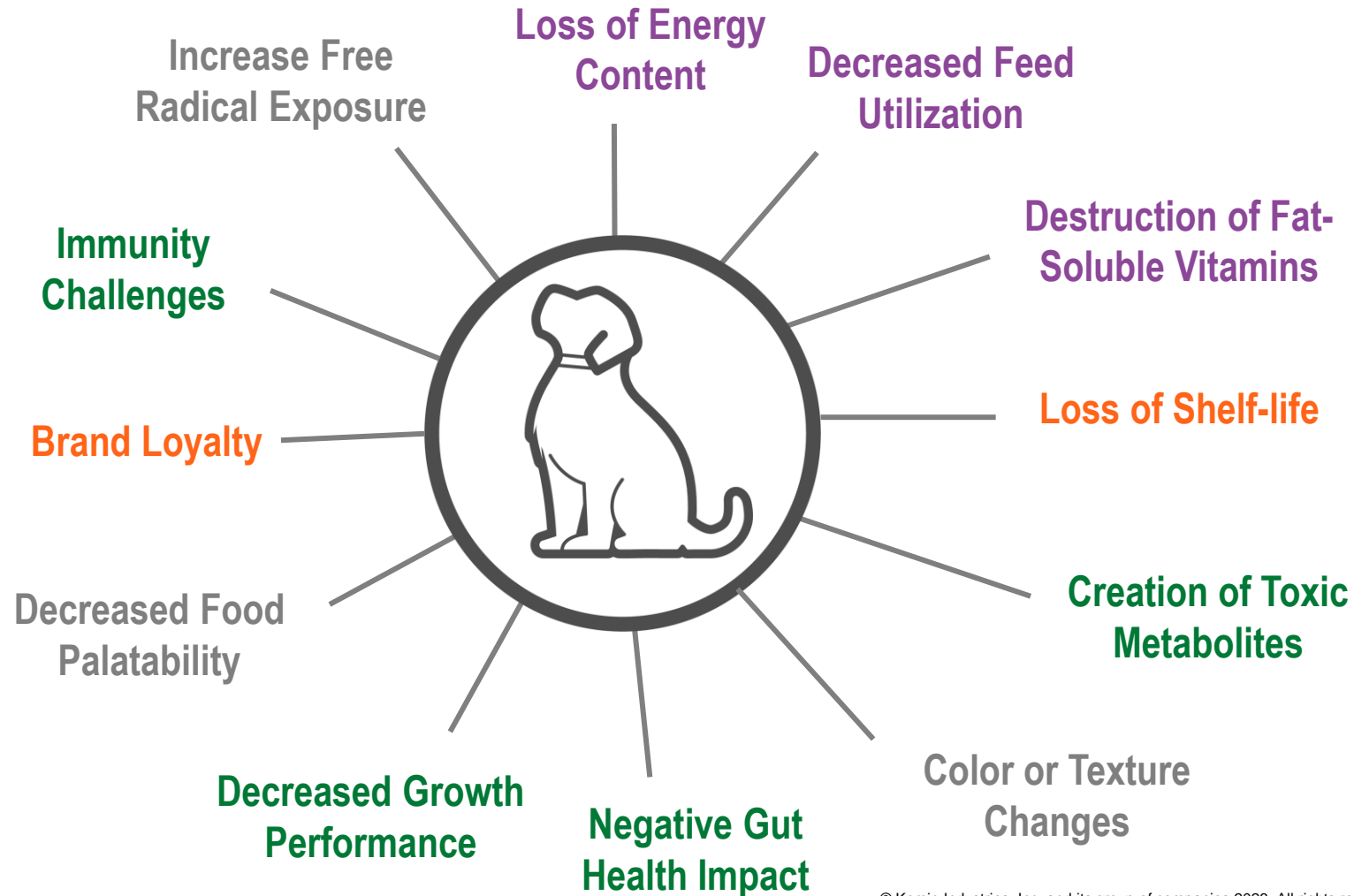
Once oxidation starts it cannot be undone.

QUALITY

HEALTH

NUTRITION

ECONOMIC

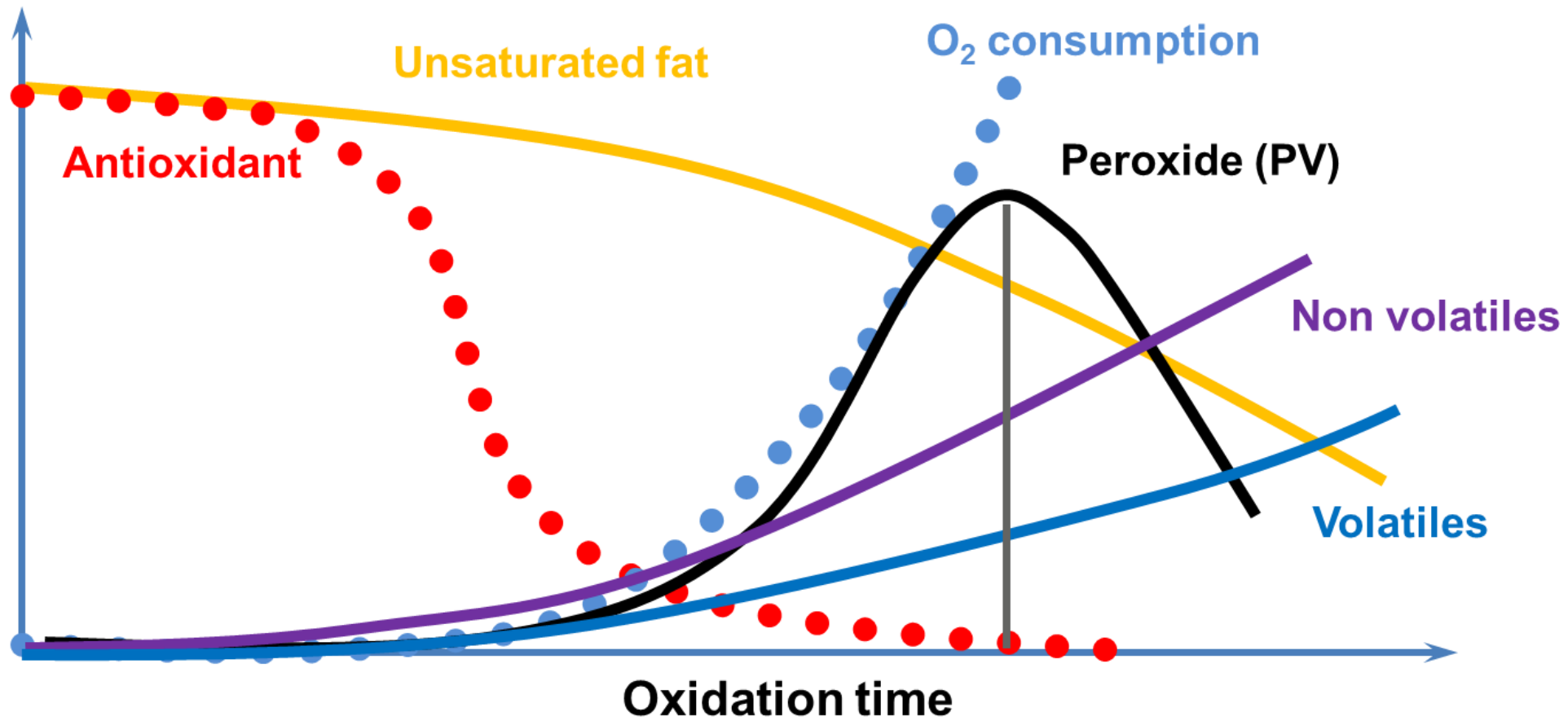


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Managing Impact of Oxidation Challenges on Quality



Lipid Oxidation Summary



Quality Occurs Every Step of the Way – Raw Material to Pet Food

Raw materials



Rendering



Transport



Pet food
manufacturing



Life on the shelf



Pet bowl



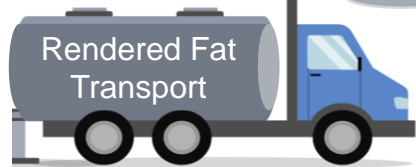
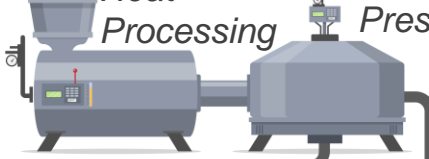
Rendering Raw Materials

Sizing



Heat Processing

Press



Rendered Fat Transport



Rendered Meal Transport

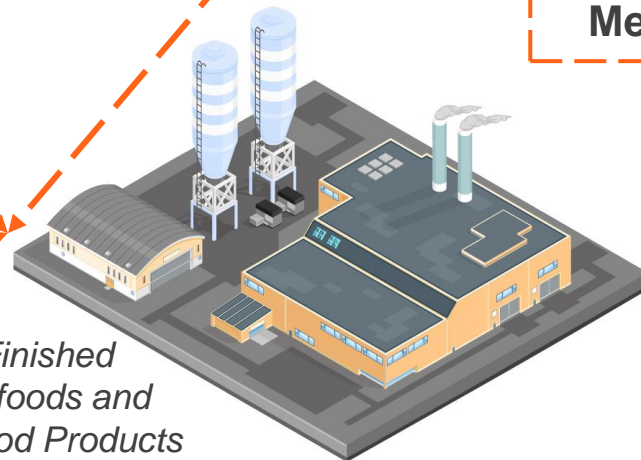
Rendered Bulk Fat

Rendered Protein Meal

Export Meal

Ingredient Collector or Processor

Fresh / Frozen Meat Ingredients, Meat Batter & Slurry



Finished Petfoods and Petfood Products

Wet Pet Food Canned Diets

Fresh / Raw Meat Diets & Products

High Meat Treats & Pet Jerky

Dehydrated & Freeze-Dried Meat Products

Dry Diets & Treats

Bird Seed

Small Animal Diets

Distribution Transport



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Proactive Oxidation Management

Understand and limit factors that influence oxidation

- Manage fat and oil storage conditions → clean fat tanks
- Unsaturated oils are highly susceptible to oxidation
- Avoid mixing vitamins and minerals (antioxidant sacrifice)

Antioxidants can be used to help manage oxidation risks

- Choosing the right antioxidant for an application is key
- Application of antioxidant early and in right location

Antioxidants are an inexpensive way to address oxidation

- Understand impact of formulation changes
- Have good quality program
- Understand entire value chain





Factors Impacting Antioxidant Application and Selection

- 💧 Where/how to apply antioxidant
- 💧 How to use antioxidants
- 💧 Type of fat utilized
- 💧 Product formulation/recipe
- 💧 Designing the right trial
- 💧 *New suppliers*
- 💧 *Packaging*

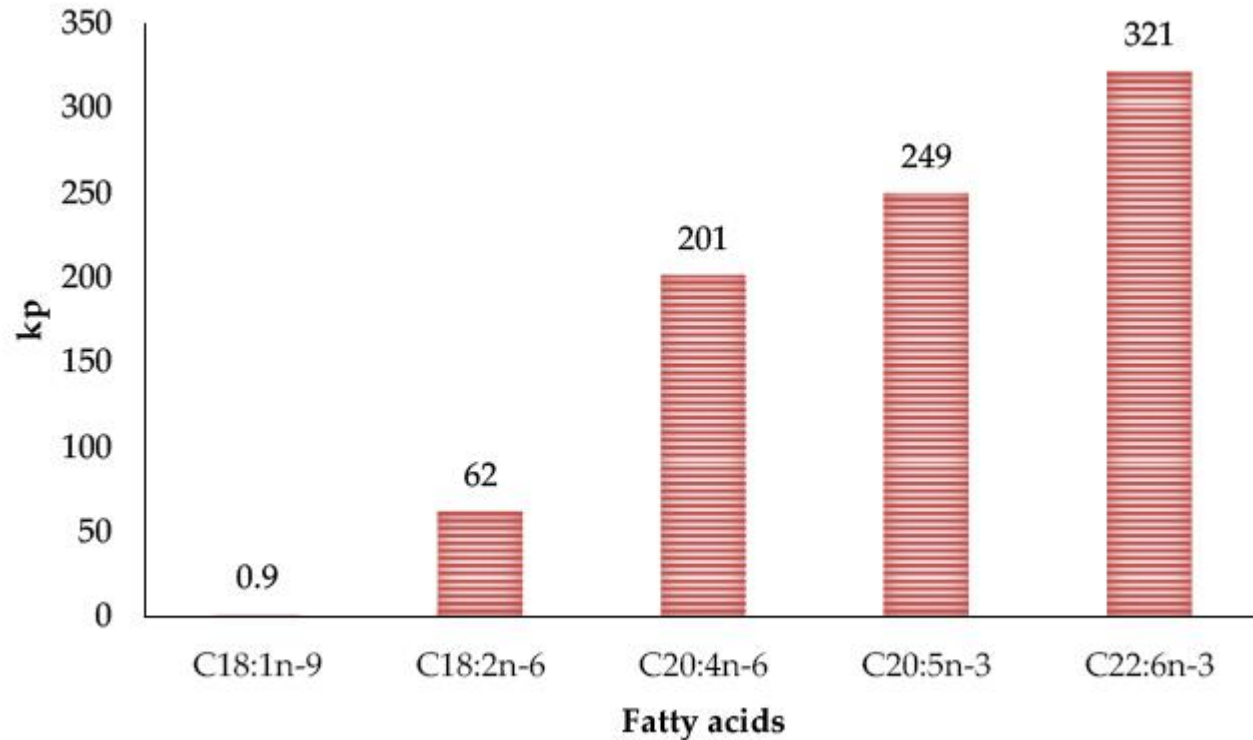
Ingredient Screening



- ◆ Impact of fatty acid composition
- ◆ Screen ingredients for oxidative potential
- ◆ Design ingredient specs to ensure good quality
- ◆ Introduce antioxidant at earliest point
 - ◆ At low PVs for fats (< 2 meq/kg fat) or meals ($< 10-15$ meq/kg fat)
 - ◆ Understanding PV methodology
- ◆ Select antioxidant type and treatment plan for optimum performance in each substrate

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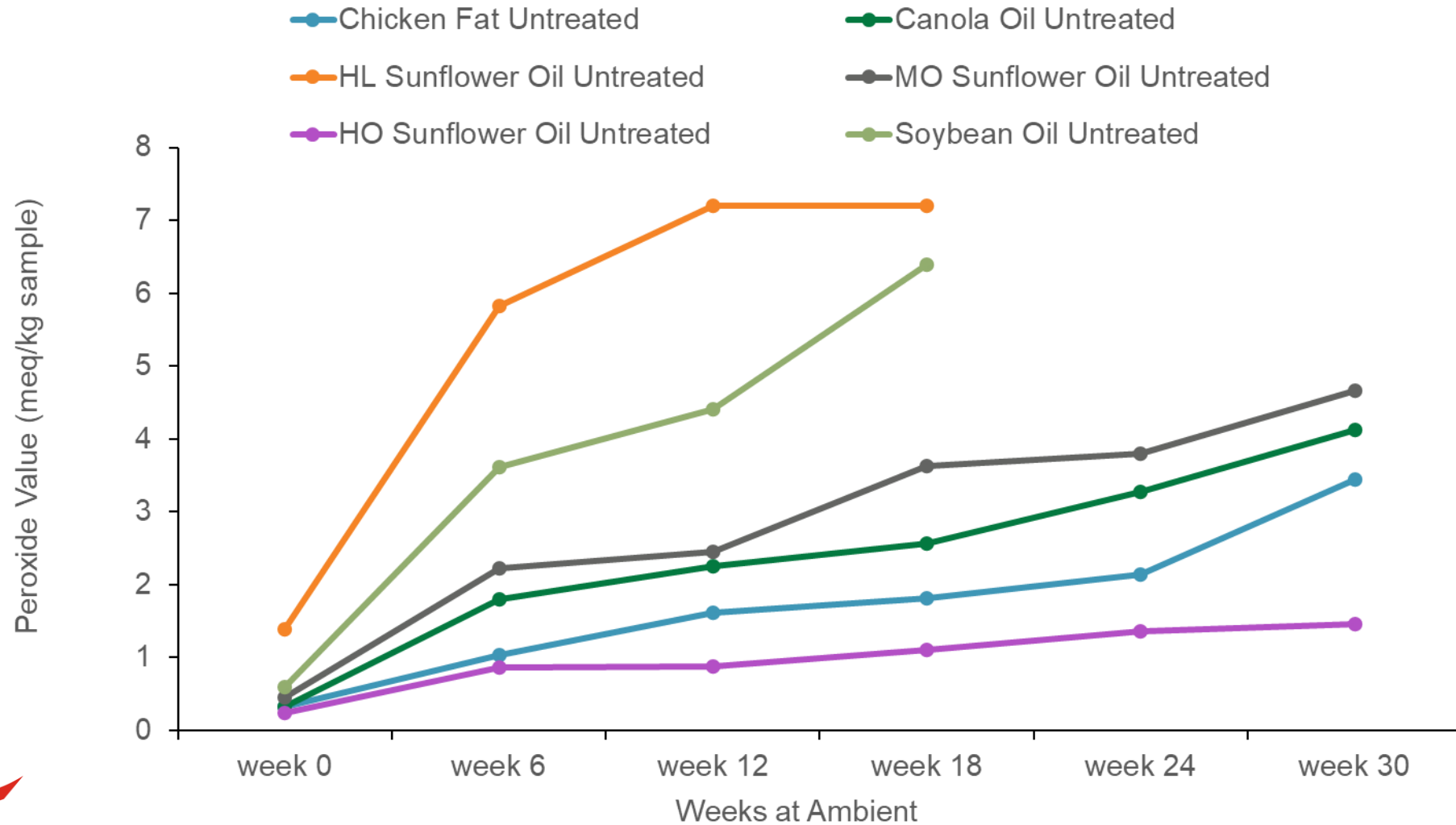
Lipid Propagation Rate (kp)



Oleic, linoleic, n-6 fatty acid, EPA, DHA

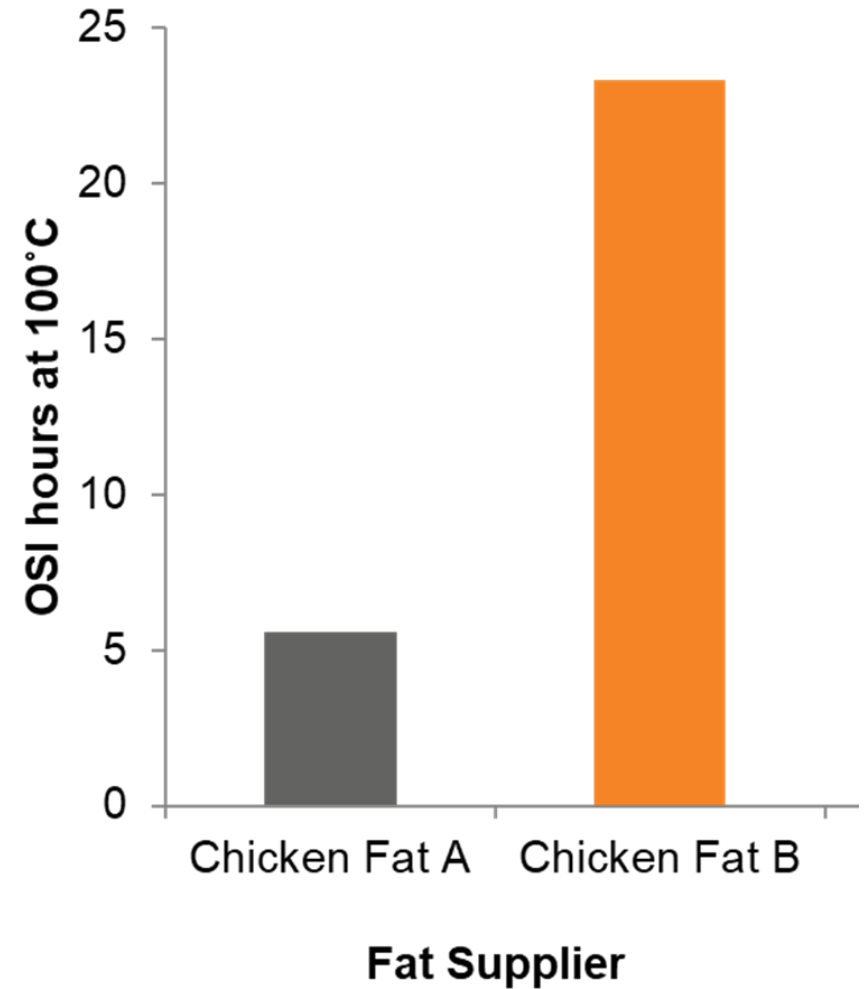


Finished Diet Design- Enrobing Fat

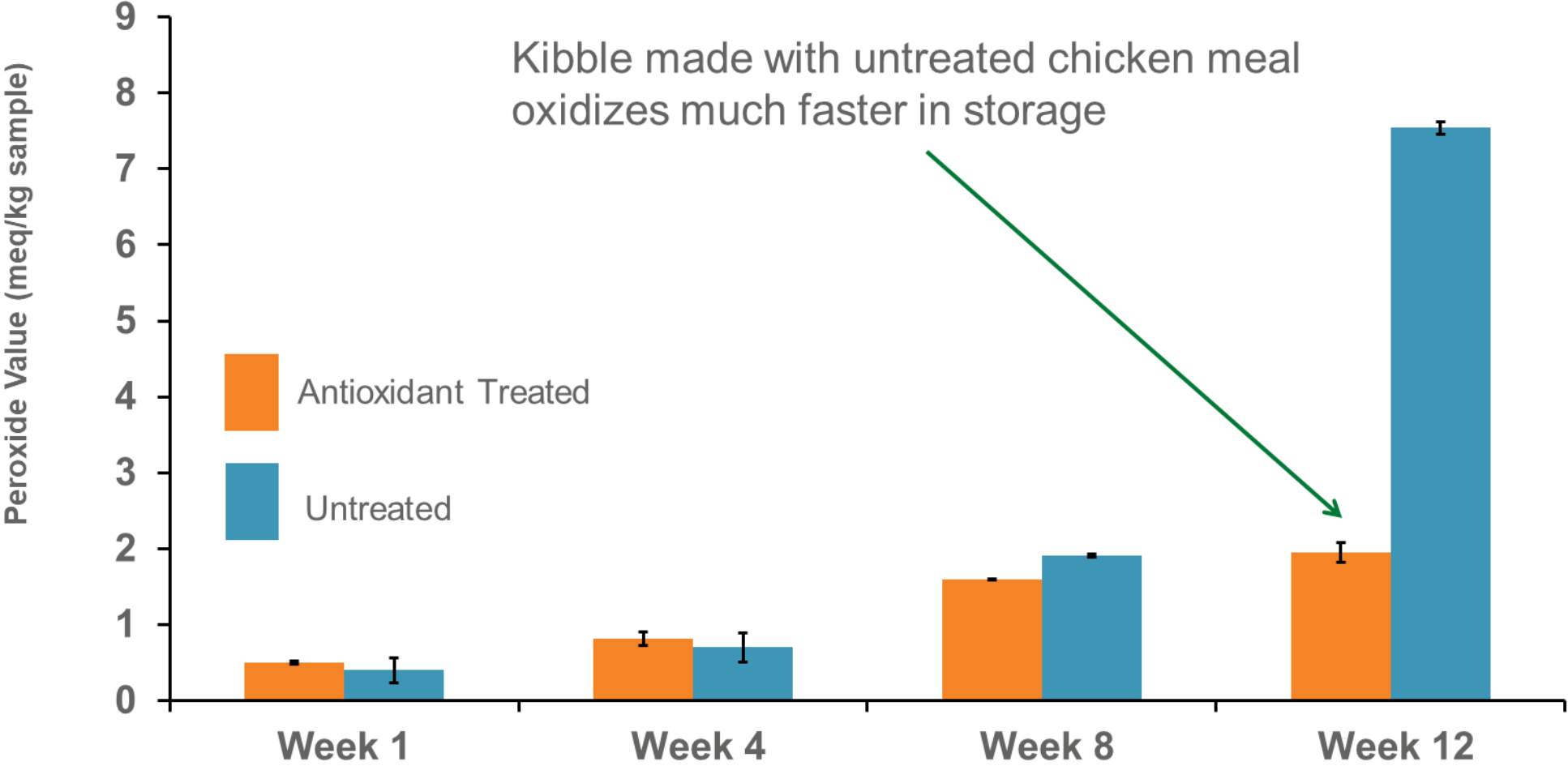


Impact of Supplier

- 🔹 Appearance, fatty acid profile and
 - 🔹 oxidative stability can vary by supplier
 - 🔹 Can have seasonal variation
 - 🔹 Can vary with changing diet composition
- 🔹 Processing and origin of materials contribute to differences
- 🔹 Monitoring suppliers via vendor assurance assists in consistent quality

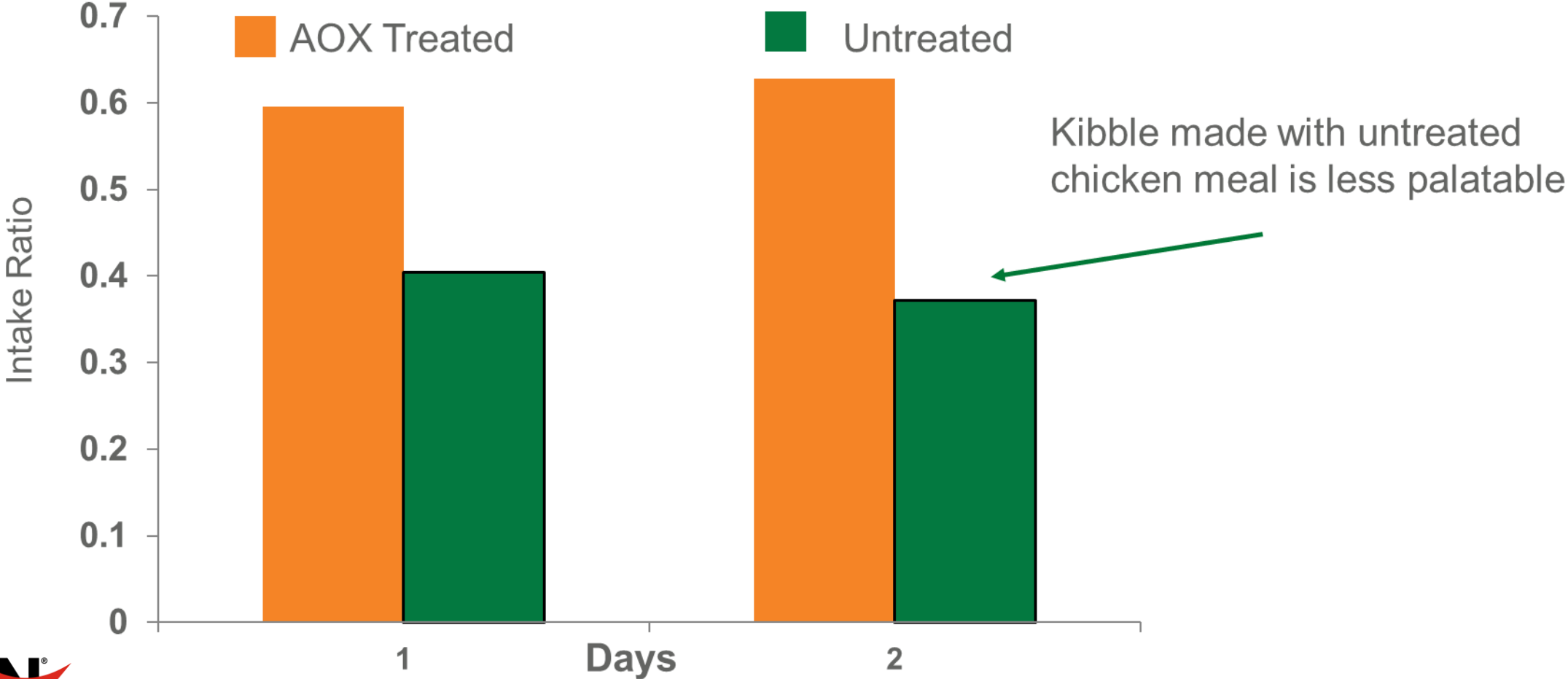


Raw Material Antioxidant Treatment Impact on Shelf-Life

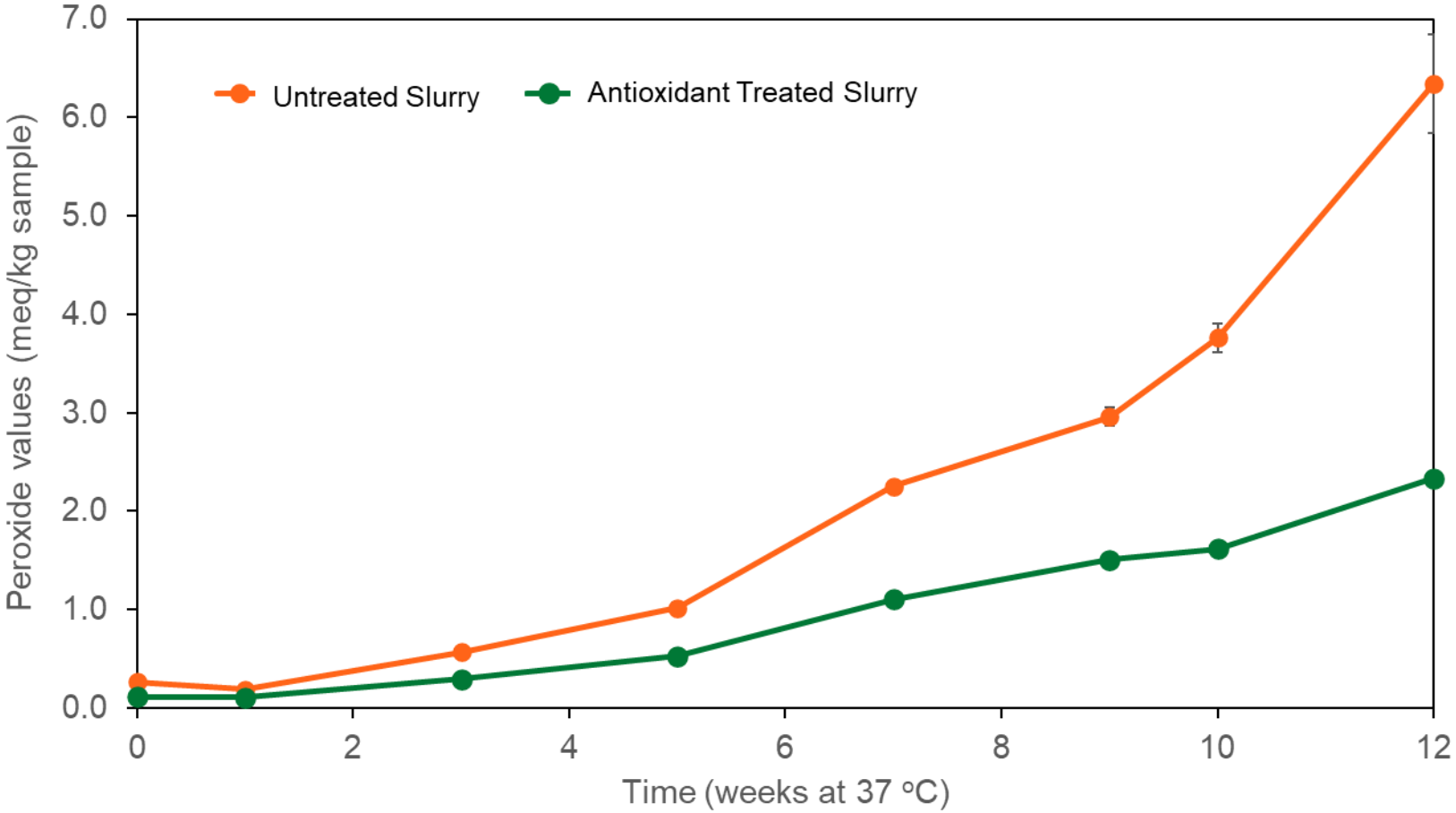


Cat Diet Palatability Study

Protein Meal Oxidation



Impact of Meat Slurry Preservation on Diet Shelf Life



Untreated product:

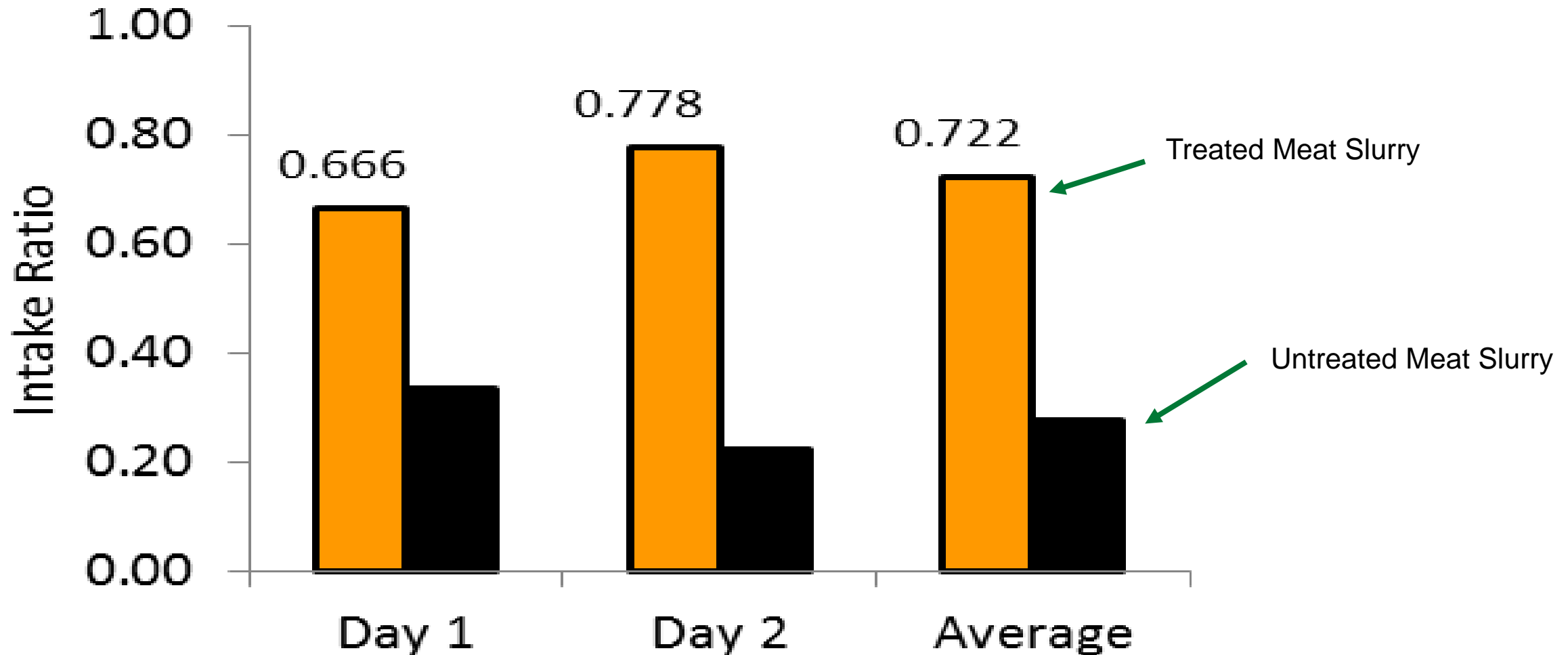
- 23.5% chicken slurry
- 16% crude fat
- 500 ppm Antioxidant in core

Treated product additions:

- Antioxidant added to slurry

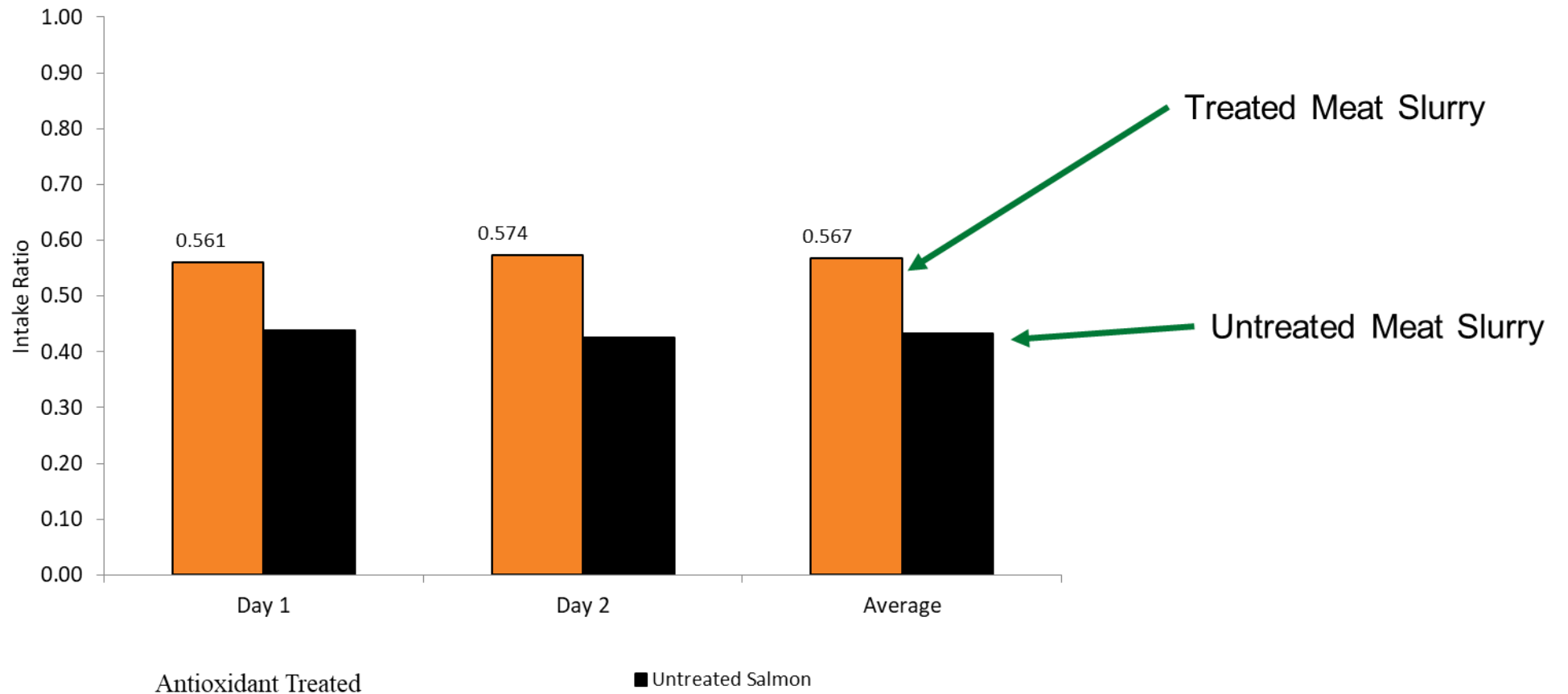


Aged Meat Slurry Preservation Dog Palatability



- Palatability of aged, untreated meat slurry compared to aged (4 days @ 4 °C), Antioxidant treated meat slurry
- Dogs (N=20) showed preference toward kibbles made with treated meat slurry.

Aged Meat Slurry Preservation Cat Palatability



- 25% Meat Slurry in recipe
- Palatability of aged, untreated meat slurry compared to aged, Antioxidant Dry treated meat slurry
- Meat slurry refrigerated (4 °C) with either treatment 4 days prior to extrusion
- Cats (N=20) showed no statistical preference toward untreated meat

Aldehyde Testing & Impact on Dog Palatability

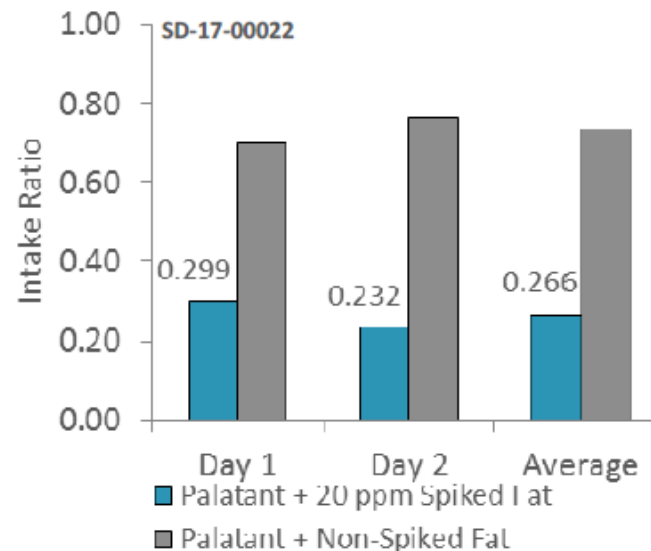
Below data shows a significant reduction in palatability when 20 ppm of synthetic Total Aldehydes (Hexanal + 2,4-Decadienal) are added to pet food.

Variable A

- 2.0% Palatant
- 6.5% Chicken Fat with 3000 ppm Natural Antioxidant + 20 ppm combined oxidatives

Variable B

- 2.0% Palatant
- 6.5% Chicken Fat with 3000 ppm Natural Antioxidant



Results

Analysis	A	B
2,4-Decadienal (ppm)	11	6
Hexanal (ppm)	5	3
Peroxide Value (mEq/kg)	0.47	0.51

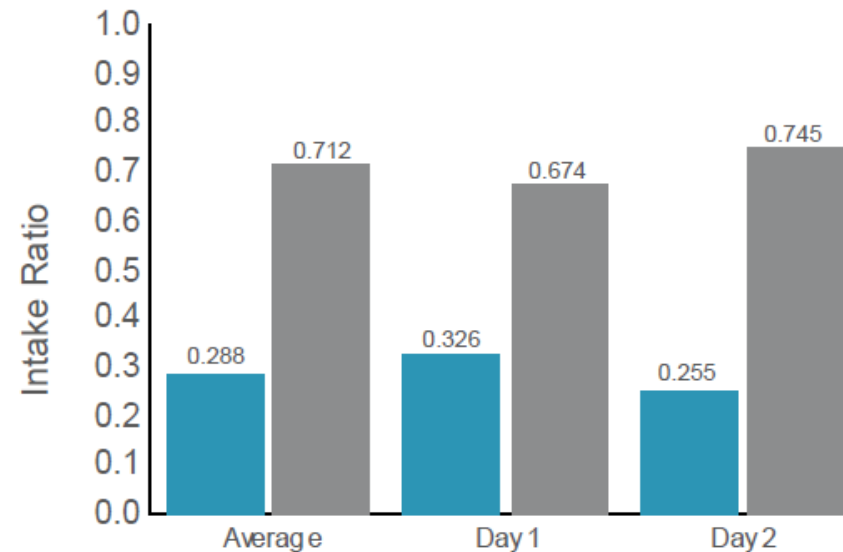
Average IR-A = 0.266
p = 0.00340



Aldehyde Sensory Impact- Cat

- Data show a significant reduction in palatability when 20 ppm of synthetic Total Aldehydes (Hexanal + 2,4-Decadienal) were added to petfood.

Physical Analysis	Ration A	Ration B
2.4-Decadienal (ppm)	9	2
Hexanal (ppm)	4	3
Moisture (%)	7.97	8.57
Peroxide Value (FOXII) (mEq/kg Sample)	0.27	0.24



Shelf-Life Expertise

Pet food product oxidation control, palatability, food safety and nutrition.



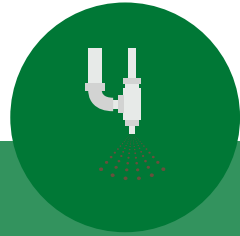
Ingredients

Market trends

Ingredient interactions

Risk assessments

Regulations



Processing

Raw material selection

Application equipment

Extrusion and drying

Coating and palatants



Testing

Stability testing

Palatability testing

Study design and protocols



Data Analysis

Data interpretation

Results validation

In-depth presentations and reporting





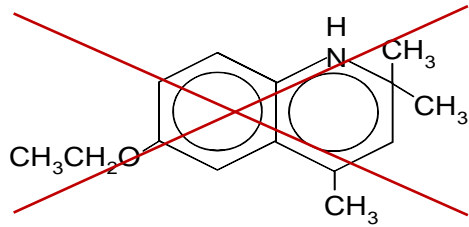
Marketing and Research Opportunities



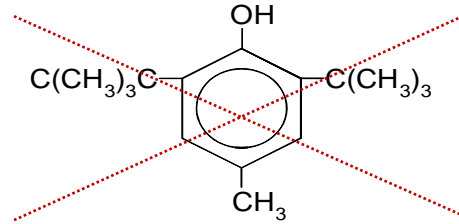
Synthetic Antioxidant Concerns

- **R51/53 hazard** (Dangerous for the environment, very toxic to aquatic organisms and may cause long-term adverse reaction).

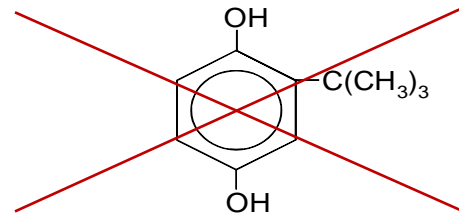
- De-authorized in EU in 2017



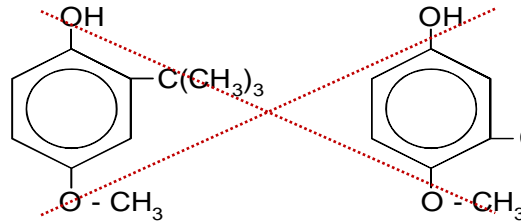
Ethoxyquin
Mol. Wt. 217



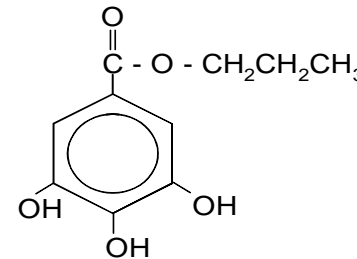
Butylated hydroxytoluene (BHT)
Mol. Wt. 220



Tertiary butylhydroquinone (TBHQ)
Mol. Wt. 166



Butylated hydroxyanisole (BHA)
Mol. Wt. 180



Propyl gallate
Mol. Wt. 212

- Lack of broad global approval

- Derived from natural sources

- Endocrine disrupter effect.
- R40 hazard (Limited evidence of carcinogenic effect)
- **R51/53 hazard** (Dangerous for the environment, very toxic to aquatic organisms and may cause long-term adverse reaction).

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Natural Antioxidant Trends

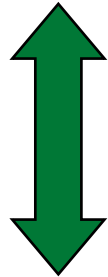
- Concerns over chemical ingredients
- Safety concerns with synthetic phenolic antioxidants
 - EQ safety challenges in US in 1990's
 - EQ deauthorized in EU in 2017
- Market trends support adoption of more label friendly ingredients
 - Clean labels
 - Premiumization / Humanization
- Sustainability
- Interest in potential Health benefits of Antioxidants



Antioxidants for Pet Foods

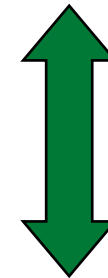
Biological
Antioxidants:

control oxidation reactions in the
animal's tissue



Physical Antioxidants:

control autoxidation reactions in the
animal's food

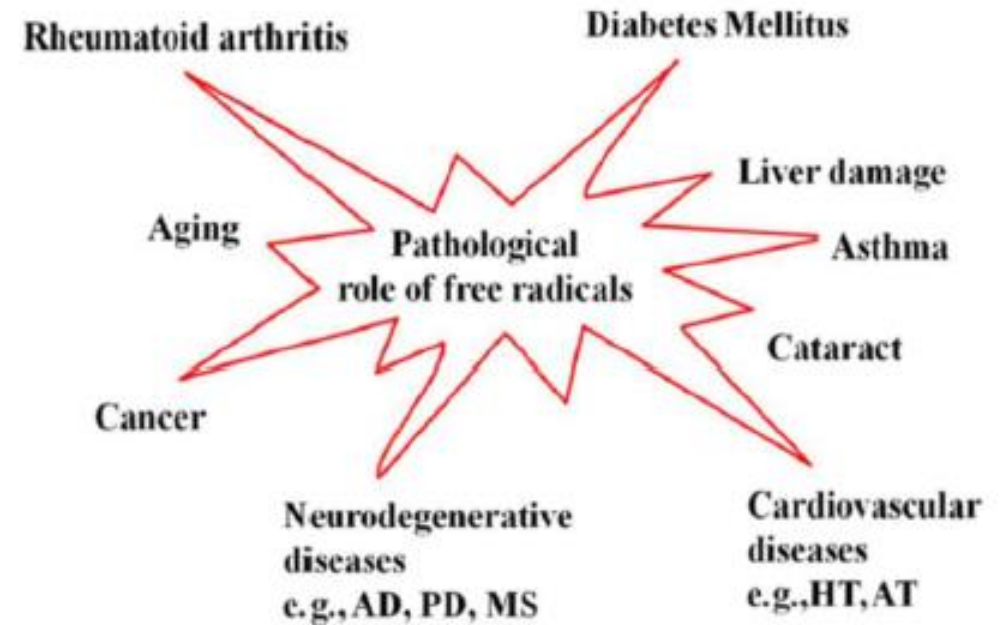


(which reduces challenge to the animal)



Risks of Lipid Oxidation

- Evidence suggests many age-related diseases can be associated to free radical damage
- Young & elderly animals can be compromised by free radicals due to stress factors
- As pets live longer it is more common to observe “human” diseases



Phaniendra et. al., 2015. DOI 10.1007/s12291-014-0446-0

Interest in Potential Health Benefits

- Many exogenous antioxidants destroyed through processing
- Antioxidants that are biological available have shown potential benefit
 - Decrease in oxidative stress
 - Anti-inflammatory impact
 - Mitigate free radical damage
 - Anti-tumor and chemo preventive
 - Reduce risk of chronic diseases
- Further research needed to support utilization of antioxidants as a strategy to support management of oxidative stress in the animal



Thank You

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