2020 AOCS Annual Meeting & Expo Lipid Oxidation and Quality Abstracts

June 29 to July 3, 2020

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For more information, please visit https://annualmeeting.aocs.org.

Presentations dated Friday, January 1, 2021, were provided on-demand.

Lipid Oxidation and Quality

Tuesday, June 30, 2020
Session Time: 10:25 AM - 12:35 PM
Presentation Time: 11:20 AM - 11:20 AM
Track: Lipid Oxidation and Quality

(3484) Antioxidant Activity Evaluation of Tocored with Three Different Methods

Presenting Author: Liyou Zheng - Anhui Polytechnic University

Tuesday, June 30, 2020
Session Time: 10:25 AM - 12:35 PM
Presentation Time: 12:10 PM - 12:35 PM
Track: Lipid Oxidation and Quality

(4211) Technology of Pretreatment for Cold Pressed, Expeller Pressed and Pre-pressed and Solvent Extracted Mustard and Canola Residues: Extractability of Canolol

Presenting Author: Usha Thiyam-Hollander, PhD - University of Manitoba

A variety of food products use mustard as a food ingredient due to its unique characteristics and properties, such as sharp flavor and bright colour. While it is a popular condiment, the potential of generating new products from mustard using thermal processing remains to be explored. Regarding the application of natural extracts in vegetable oils, one of the major limitations is the poor lipophilic nature of polyphenols Our past works on canola extensively studied thermally-aided wet-extraction to generate innovative green processing and co-processing technologies. Canola by-products were subjected to accelerated solvent extraction (ASE) and RapidOxy 100 roasting pre-treatments. This study employed a new thermal treatment namely- air frying and RapidOxy 100 to roast both high and sample-grade mustard varieties and their fractions, for the production of new ingredient-co-streams. Air frying temperatures (160-180oC) were the primary factors affecting the major lipid- soluble sinapic acid derivatives and the antioxidant canolol. The

results obtained support a time-temperature dependent correlation for these compounds. The high-temperature processing thermally induced reactions that significantly affected the flavour and phenolic profile of mustard. A considerable amount of canolol was extracted from oil fraction which supports its lipophilic nature. Such treatments can enrich mustard-based ingredients with canolol and other flavor-active compounds. This study was interrupted by the current Covid-19 situation but will be continued once our return to the research laboratory is approved.

Wednesday, July 1, 2020
Session Time: 8:25 AM - 9:45 AM

Presentation Time: 9:20 AM - 9:45 AM

Track: Lipid Oxidation and Quality

(3916) Oxidative Stability of Chia Seed Oil Essential Fatty Acids Encapsulated by Amylose-inclusion Complexation

Presenting Author: Andrea Di Marco - Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA)

Beneficial effects of polyunsaturated fatty acids on health have generated increasing efforts for their incorporation into diet. Nevertheless, their high susceptibility to oxidative degradation have promoted the development of encapsulation technologies. Chia seed oil is known as a rich natural source of omega-3 and omega-6 fatty acids. In this work, essential fatty acids obtained by enzymatic hydrolysis of chia seed oil were encapsulated by inclusion complexation with amylose under the alkaline method. The effect of crystallization temperature (50, 70 and 90 °C) on the physicochemical properties of the samples was studied. The formation of amylose V-form was confirmed by X-ray diffraction. The C18:3 and 18:2 content of samples determined by gas chromatography was in the range of 2.4 – 3.0%. Peak melting temperatures determined by DSC were higher than 86 °C, showing an increase as the temperature of crystallization was increased. Results obtained by thermogravimetric analysis have shown that free fatty acids exhibited a mass gain associated to oxygen uptake, while it was not observed for amylose-lipid complexes, thus suggesting a protective effect of polyunsaturated fatty acids from oxidative deterioration. According to these results, amylose-lipid complexes would represent a promising delivery system for the incorporation of essential fatty acids into foods.

Wednesday, July 1, 2020
Session Time: 8:30 AM - 9:45 AM

Presentation Time: 9:20 AM - 9:45 AM

Track: Lipid Oxidation and Quality

(3847) Synergistic antioxidative performance of polyamines on oxidative stress to lipid by *in vitro* model system

Presenting Author: Atsushi Takahashi - Tohoku University

In recent years, polyamines have attracted much attention in lifespan-extending property. Aging is believed to be associated with oxidative stress. In neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, which are aging-related diseases, oxidative stress markers such as lipid peroxide have been reported to be increased. Recently, polyamines are shown to be effective or highly related to these neurodegenerative diseases. This suggests that polyamines have some influence on oxidative stress. However, its role against the oxidative stress has yet clarified. In this study, as the first step for verification of lifespan-extending effect by polyamines, we investigated how polyamines act against oxidative stress *in vitro* homogeneous lipid model system. Methyl linoleate was used as a model lipid compound. Spermine, spermidine and putrescine were used as polyamines. Vitamin E (α-tocopherol) was used as a general antioxidant within an organism. The antioxidant activity was evaluated by the Rancimat method. The experimental results showed that the induction period (IP) with spermine alone (7.0 μmol) is 0.2 h, which is 1/3 compared to that of 0.6 h with vitamin E alone at same concentration, indicating that spermine itself has only small antioxidant effect. On the other hand, co-addition of spermine and vitamin E resulted in IP of 1.3 hours. This is twice as long as IP of Vitamin E alone, suggesting that spermine synergistically protects against oxidative stress by supplementing and regenerating other antioxidants. Furthermore, when compared with other polyamines, the synergistic effect was thought to be closely related to secondary amine groups of polyamines.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(4173) Antioxidant Phenolics in Camelina and Spophia Oilseeds and Effects of Minor Components on the Stability of Their Oils

Presenting Author: Fereidoon Shahidi - Memorial University of Newfoundland

Phenolic compounds are present in different plant seeds including oilseeds. These are primarily phenolic acids and this was the case for the seed meals of camelina and Sophia. The profile of the phenlics in the meals were determined and found that they effectively inhibited oxidation in different systems by exerting antioxidant effects. The extracted oils were also subjected to autoxidation under accelerated oxidation as well as photooxidation as such or after the removal

of their minor components. The oils devoid of their minor components were much less stable under Schall oven condition but the reverse was observed under photooxidation. Thus, under autoxidation, the tocopherols present exerted a dominant effect that overwhelmed the effect of other minor components. However under photooxidation conditions, the photosensitizing effect of chlorophylls and carotenoids hastened the oxidation beyond the protection that was provided by tocopherols in the oils. These results reveals that camelina and Sophia seed meals and oils are important sources of raw material for inclusion in selected specialty foods or used as such in different applications.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3673) Effect of Incorporation and Vectorization on Antioxidants Efficiencies in Emulsified systems

Presenting Author: Pierre Villeneuve - CIRAD

Lipid oxidation is a major challenge in the food and cosmetic industries especially when emulsified systems are involved. In such systems, the lipid oxidation mechanisms and the efficiency of added antioxidants are governed by a combination of chemical and physico chemical phenomena. While numerous compounds are described as antioxidants and well-characterized in terms of chemical reactivities, there is still a lack of knowledge for the prediction of their efficacy in emulsions. Indeed, researchers have to assess not only the global reactivity of all of the molecules concerned by the lipid oxidation in the system but also their interactions, their location, and their potential transport. In this presentation, we will focus on some of our recent results trying to identify key physical parameters that govern antioxidant efficiencies in emulsified medium. For this, the behaviors of various phenolic compounds and their phenolipids counterparts were investigated in correlation with their mode of incorporation, their localization in the different phases of the studied emulsions and their potential vectorization through the use of natural or synthetic vesicles.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3720) Effect of Rye Bran-Derived Alkylresorcinol Chain Length on Antioxidant Activity in Bulk Oils and Emulsions

Presenting Author: Andrew S. Elder - The Pennsylvania State University

The food industry is under tremendous pressure to replace synthetic antioxidants with natural alternatives due to negative consumer perceptions of synthetic ingredients and their purported toxicity. However, these natural antioxidants have reduced efficacy compared to their synthetic counterparts. One means to address this is through the optimization of antioxidant activity for a food system through lipophilization. A drawback to this is that it effectively converts a natural antioxidant into a synthetic version. Alkylresorcinols are a naturally occurring homologous series of phenolipids found in the bran layer of grains which have been shown to function as antioxidants in fatty acid solutions. Alkylresorcinols vary with respect to their alkyl chain length (13 – 27 carbon atoms) and, therefore, have the potential to exhibit increased antioxidant activity in emulsified foods as they can partition to different phases of the emulsion due to their amphiphilic nature. To investigate this, alkylresorcinols were extracted from rye bran, purified via winterization, and spiked into stripped algae oil. The rye bran extract, rich in a mixture of alkylresorcinol homologues, was found to inhibit oxidation reactions in oil-in-water emulsions. Individual alkylresorcinol homologues were subsequently isolated via prep-HPLC. It was found that alkylresorcinols were responsible for the observed antioxidant activity of the rye bran extract with optimum activity at intermediate chain length (C21:0) in emulsions but decreasing activity with increasing chain length in bulk oils. Additionally, alkylresorcinols were able to scavenge oxygen radicals but not chelate iron. Finally, the antioxidant activity of individual alkylresorcinol homologues were investigated in real food systems.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3870) Canolol - Properties, Processing and Use

Presenting Author: Frank Pudel - Pilot Pflanzenöltechnologie Magdeburg e.V.

Canolol can be produced from canola meals enzymatically or chemically. It is characterized by high antioxidative as well as bioactive potential. The presention will give an overview on its properties, alternative processing technologies and use possibilities.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3744) Clean Label Antioxidants for the Shelf Life Extension of Fried Snack Foods

Presenting Author: Lan Ban - Kemin Food Technologies

Frying oil quality deterioration results in reduced shelf life of fried snack foods. A common strategy is to use antioxidants to delay oxidative breakdown of the carry-over oil in the fried food. However, the shelf life of the fried food is affected by all stages from pre-frying (transportation and storage of the oil), frying, to post-frying storage of the food. The mechanistic actions of antioxidants in the three stages are likely to be different, which are strongly influenced by factors such as temperature and system chemical compositions. Secondly, antioxidants display different modes of actions depending on their physio-chemical properties. The primary objective of this study is to deliver a clean label antioxidant package with different modes of actions to provide oxidation control in pre-frying and frying stages which results in delaying oxidation in fried foods. A secondary objective of this study is to assess up-scaling stability of commodity oils to that of high oleic oils without compromising the shelf life of the fried food. Corn tortilla chips and canola oil are used as model systems. Free radical scavengers, oxygenated species reducers and metal ion chelators with varying polarities are tested in a batch frying system. The quality parameters of fried chips such as free fatty acids, peroxides, aldehydes and sensory acceptance are monitored for extended period and the correlation to the frying oil quality was evaluated. The study hopes to fill in the gap of mechanistic understanding of antioxidant performance and offer consumer friendly options for healthier fried snack foods.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3896) Effects of Physical Treatments on the Oxidative Stability in Edible Oil

Presenting Author: JaeHwan Lee - Sungkyunkwan University

Diverse physical techniques have been attempted in food industry as alternative or supplementary tools to decrease disadvantages of thermal energy. One of such techniques is using microwave irradiation. Microwave can generate heat when dielectric substances having permanent or induced dipoles are exposed to certain wavelength like 2450 MHz. Dipolar polarization and ionic conduction or their combinations are major mechanisms for microwave heating. Only 30 min of microwave treatment induced similar degree of CDA value compared to 100°C for 24 h and 180°C for 4 h. Effects of amphiphilic compounds including oleic acid, lecithin, and MAGs on the oxidative stability were evaluated in corn oil by microwave treatment. Added lecithin increased moisture content while oleic acid and MAGs did not show such effects.

Conjugated dienoic acid value in all samples increased irrespective of amphiphilic compounds. p-Anisidine values in corn oil containing oleic acid decreased whereas lecithin added samples had higher p-anisidine values. Significant difference in tocopherol contents were not observed in corn oils containing amphiphilic compounds except 0.5% MAGs. TBHQ showed the lowest CDA value followed by trolox, tocopherol, and green tea extracts in corn oil treated with microwave heating from CDA value while results of. p-AV showed a little different pattern. Physical treatment like microwave irradiation could be a new way to produce the fried foods in edible oils.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(4121) Overview of oil quality change during frying for high quality fried products in food service

Presenting Author: Xiaolan Luo, PhD - Cargill

Deep-fat frying is a fast and convenient procedure that offers foods with pleasing flavors, golden-brown color, and desirable crispy texture to consumers. It is a complex process involving in a wide variety of chemical reactions, such as hydrolysis, oxidation, and polymerization. Considerable research efforts have been dedicated to understand reactions in frying and factors impacting frying oil quality. Color, free fatty acid (FFA), and total polar material content (TPM) are three major parameters commonly used in industry/quick service restaurants to monitor oil quality during frying process. The aim of the work is to review the change of oil quality over frying and give a systematic understanding of the impact of frying conditions on qualities of oil and fried products including color, texture, and acrylamide level for solutions of delivering high quality fried products in food service.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(4034) Transition metals shift products as well as alter rates in catalysis of lipid oxidation

Presenting Author: Karen M. Schaich - Rutgers University

Metals have long been recognized as perhaps the most ubiquitous catalysts of lipid oxidation in oils and foods, so chelators are routinely added for control. Even so, metal catalysis of lipid oxidation in foods remains poorly understood, especially in terms of effects on oxidation pathways and product distributions, food quality, and development of potentially toxic compounds. Despite the importance of metals in lipid oxidation, over the past 30 years little

research has been focused on problems created by metals, but with current reformulation of foods to include essential polyunsaturated fatty acids, concern about oxidation has again come to the forefront. At the same time there is increasing recognition that lipids oxidize by multiple pathways. Hence, now is an opportune time to revisit the role of metals in lipid oxidation, examining their multiple catalytic mechanisms and how they may shift lipid oxidation pathways and products as well as increase oxidation rates. This paper presents an overview of mechanisms by which metals catalyze lipid oxidation, with emphasis on important changes in product distributions mediated by metals. These altered oxidation patterns will then be connected to effects on food quality for consumers and to new challenges to analytical capabilities in quality control and research. Important aspects of metal catalysis of oxidations needing up-to-date research will be identified.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(4209) The Furan Fatty Acid 9M5 Acts as a Partial Ligand to PPARγ and Enhances Adipogenesis in 3T3-L1 Preadipocytes

Presenting Author: Anna-Karina Becker - Institute of Biological Chemistry and Nutrition, University of Hohenheim

A food that has been praised for its beneficial effects on overall health is fish, in particular its polyunsaturated omega-3 fatty acids including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). However, it has recently been suggested that minor fatty acids such as furan fatty acids are needed in combination with DHA and EPA to exert these positive effects of fish and fish oils. Only recently have furan fatty acids become available in quantities that allow investigation of their biofunctional properties. In this study the uptake and effect of the furan fatty acid 9-(3-methyl-5-pentylfuran-2-yl)-nonanoic acid (9M5) as a sole component and in combination with DHA and EPA on adipogenesis was analyzed using the 3T3-L1 cell model. 9M5 is taken up and metabolized into 7M5, 5M5 and 3M5 in 3T3-L1 adipocytes during a 24 h period as shown with GC/MS. Furthermore, 9M5 significantly increased lipid accumulation during the differentiation process of 3T3-L1 preadipocytes into adipocytes. In addition, the combinations of DHA + 9M5 and EPA +DHA + 9M5 also exerted a significant increase compared to control adipocytes. 3T3-L1 cells incubated with 9M5 resulted in an increased protein expression of PPARγ, C/EBPα, FABP4, and adiponectin, although not to the extent as DHA as a sole component or DHA + 9M5 did. Earlier studies have shown that DHA is a natural ligand for PPARγ thus being a potential alternative to the antidiabetic thiazolidinediones. We show that 9M5 activates a PPARγ responsive reporter gene and could therefore be a natural ligand for PPARγ.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3622) Mechanisms of Antioxidants Action in Food/Pet Food and Application of Antioxidants in Food/Pet Food Industry

Presenting Author: Min Hu - DuPont Nutrition & Health

Mechanisms of antioxidants action in food/pet food and application of antioxidants in food/pet food industry The cut-off effect or nonlinear phenomenon has been put forward to explain the mechanisms of antioxidants action in bulk oil and food emulsions after the polar paradox theory. However, the cut off effect may not explain mechanisms of antioxidants action in low moisture foods. For instance, in extruded pet foods and crackers, the mechanism of antioxidants action may be different from the bulk oils and food emulsions, when transition metal ions are involved in the food systems studied. As for extruded pet food,dry pet food oxidation is not only related to coated oil/fat but to kibble matrix. In addition, dry pet foods may contain higher level of ferrous iron. But the ferrous iron may not be a pro-oxidant. Further, it is a big challenge for food industry to select appropriate natural antioxidants applying in food products based on the cut-off effect. Therefore, the new theory may be needed to explain mechanisms of antioxidants action in various foods like low moisture foods and to give the guidance for food/pet food industry to develop and select antioxidants used in various lipid-containing foods. In the presentation, we will briefly discuss advantages and disadvantages of the polar paradox theory and the cut-off effect, possible mechanism of antioxidants action in lower moisture foods and possible explanation for antioxidant action in dry pet food, as well as the big challenges when selecting antioxidants in real food matrices based on polar paradox theory and cut-off effect.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3758) Oxidative Stability of Rendered Ingredients and Pet Food

Presenting Author: S.P.J. Namal Senanayake - Camlin Fine Sciences

Lipid oxidation is one of the main processes that irreversibly affects the oxidative stability and shelf-life of rendered fats and oils, animal protein meals, and finished pet food products. The addition of antioxidants to rendered fats, meat meals and other rendered ingredients, as well as finished pet food products effectively delays oxidative deterioration of lipids. The synthetic antioxidants have been widely used in finished pet food products and pet food ingredients; however, the current trend is to substitute synthetic ingredients with natural alternatives due to increasing popularity of pet food products with natural and organic attributes. Due to growing awareness of humanization of pets, improving oxidative stability of these food grade ingredients

in pet food is of greatest importance. In this presentation, the target measures of oxidation in rendered fats and animal protein meals will be addressed. In addition, the effectiveness of naturally derived antioxidants as opposed to synthetic antioxidants in pet foods and pet food ingredients will be discussed.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(3816) Use of the CDR Foodlab Analyzer for Testing Peroxide Value of Meat Meals

Presenting Author: Jennifer M. Schofding - Quartz Analytics

The Pet Food Industry currently uses Peroxide Value to assess oxidation levels in meat meal. Lack of industry standardization of a test method costs the Pet Food Industry tens of millions of dollars. Leaders in the Pet Food Industry find performing an ether extraction followed by AOCS' official Cd-8-53 titration, to be the most reliable way to test peroxide value of meat meal. The ether extraction and titration are time consuming and requires the use of experienced operators, toxic chemicals, a chemical fume hood, and specialty lab equipment. Having a rapid testing method that is as reliable as the ether extraction coupled with the AOCS official method Cd-8-53, could help eliminate the inconsistencies of testing for peroxide value in meat meals. The CDR FoodLab analyzer is a pre-calibrated, easy to use photometer tests peroxide value in a variety of fats and oils, along with baked goods and flours. A variety of 75 meat meal samples were tested using the CDR FoodLab and the AOCS official method Cd-8-53 with the ether extraction. Correlating results indicate that the CDR FoodLab analyzer can be calibrated to work for testing peroxide values in meat meals, providing a consistent, user-friendly, efficient way to test for oxidation in meat meals.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality

(4098) Challenges of Developing Oxidation Testing Models

Presenting Author: Ewa Fuller - Kemin Industries/Nutrisurance

How do you assess the performance of an antioxidant? It's a seemingly simple question, but there are countless pitfalls that can send companies down the wrong path. When developing antioxidant products for use in pet food, prototype testing is typically performed in a simplified matrix, such as an oil or a fat, instead of testing in an actual pet food. Unfortunately, antioxidant performance in an oil or fat often doesn't correlate to the same performance in a pet food or other dry matrix. In addition, accelerated high temperature conditions are often applied, which allows

for quick results. However, such approach has a very limited application to pet food and erroneous conclusions are often drawn from the use of high temperature methods. Simple matrixes fail to take into account interactions between lipids and other constituents of pet food, such as proteins, carbohydrates, and minerals. In these simple models, not all oxidation pathways are accounted for. Additionally, performance of antioxidant molecules varies with temperature, and high-temperature results, while quick, may not correspond to the performance of antioxidant molecules in an actual pet food throughout its shelf life. Examples of flawed conclusions drew from antioxidant testing in oils or fats, when in fact intended for pet food applications, will be presented. Moreover, method recommendations suitable for reliable antioxidant product development for pet food purposes, will be discussed.

Tuesday, June 30, 2020

Session Time: 10:25 AM - 12:35 PM

Presentation Time: 10:55 AM - 11:20 AM

Track: Lipid Oxidation and Quality@@@Analytical

(3849) How Should Industry and Academia Align Frying Oil Research

Presenting Author: Richard A. Della Porta, MS - Pepsico / Frito-Lay

A considered review of the current methodologies used for understanding the behavior of oils used for frying by academic researchers and how they can be applied to the needs of different industries. Patterns of experiments, conditions for testing, materials considered and how analytical methods are employed and interpreted are key elements for aligning the research to the application needed.

Wednesday, July 1, 2020

Session Time: 8:30 AM - 9:45 AM

Presentation Time: 8:30 AM - 8:55 AM

Track: Lipid Oxidation and Quality@@@Analytical

(3446) Rapid Small-Scale Oxidation Test: Screening the Influence of Antioxidants in Food and Pet Food Products

Presenting Author: Carolin Edinger - Anton Paar ProveTec GmbH

The quality of fats, oils, and food products in general strongly depends on their oxidation stability. In this contribution a new method for evaluating the oxidation stability of food and pet food products by determining the induction period is introduced. Under accelerated conditions (elevated temperature and pure oxygen pressure) a sample of 5 mL/4 g is examined in a sealed stainless steel test chamber. Typical conditions of the method are temperatures between 80 °C – 140 °C and an initial oxygen pressure of 700 kPa. These conditions initiate a rapid oxidation process, which is monitored by recording the pressure until a predefined pressure drop. It was

found that the elapsed time until the pressure drop is directly related to the oxidation stability of the sample. Correlation and precision studies demonstrate the method's effectiveness. Due to the defined oxygen volume in the closed test chamber, the oxygen consumption can be calculated. Beneficially, the oxidation stability of complex food products can be investigated since even solid samples can be measured without prior sample preparation. Application examples such as investigation of fishmeal demonstrate the broad variety of samples and the effectiveness of the method when it comes to antioxidant screening. The significantly reduced measurement time and a high repeatability of the method represent its major advantages, allowing for quick and direct measurement of the oxidation stability for research, process and test bench control.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Analytical

(3629) Determination of Lipid Hydroperoxides in Oil-In-Water Emulsions Using a Novel Technique

Presenting Author: Sibel Uluata, PhD - Inonu University

Omega-3 fatty acids have positive effect on human health and Krill oil has emerge as a new source omega-3 fatty acids. On the other hand, there is considerable interest in utilizing nanoemulsions in the food industry to encapsulate and deliver lipophilic functional agents, such as vitamins, nutraceuticals, flavors and colors. Nanoemulsions have some important potential advantages over conventional emulsions due to the high physical stability, and ability to increase the bioavailability of lipophilic bioactive. Conventional lipid hydroperoxides methods (titrimetric, AOCS, thiocyanate) did not work to determine lipid hydroperoxides in this emulsion system. DPPP (diphenyl-1-pyrenylphosphine) was used a fluorescent probe to determine lipid hydroperoxide by a novel technique. DPPP itself is not fluorescent, but when it reacts with lipid hydroperoxides, its oxide form was generated, and it has fluorescent properties. In this study, krill oil-in-water emulsions were prepared using by microfluidizer at 12000 psi pressure. The mean particle diameter was determined around 180 nm and the droplet charge (ζ-potential) was determined from -29 mV. Emulsion samples were incubated at 37oC for auto-oxidation. Lipid hydroperoxides were determined by fluorescens spectrophotometer using with DPPP probe. The results show that fluorescent technique can be used to determine lipid hydroperoxides and also this technique was more sensitive and selectivity than conventional techniques.

Friday, January 1, 2021

Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Biotechnology

(3678) Comparison of Antioxidant Activities of Selected Phenolic Compounds in O/W Emulsions and Bulk Oil

Presenting Author: Joseph R. Hyatt - University of Georgia

The antioxidant activities of 1-*o*-galloylglycerol (GG), propyl gallate (PG), rosmarinic acid (RA), and tocopherols (TOC) were evaluated in soybean oil stripped of tocopherols and its oil-in-water (O/W) emulsions. O/W emulsions prepared with various emulsifiers (Ryoto™ S970, S1170, and TWEEN® 80) at 0.1%, 0.5%, and 1.0% (w/w) concentrations were tested to find an emulsion with the lowest interfacial surface tension and stable particle size over a 30-day period. A model was constructed to correlate interfacial surface tension and actual emulsion particle size to predict emulsion stability. The O/W emulsion with the lowest particle size without change over the test period was replicated to compare against bulk oil in an accelerated 15-day oxidation study with selected antioxidants. The antioxidant activities of the four antioxidants, as well as GG/TOC and GG/RA combinations at a 1:1 ratio, were compared using 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) ($ABTS^{+\cdot}$), and ferric reducing antioxidant power (FRAP) assays. Their antioxidant effects were evaluated in bulk oil and O/W emulsions by determining peroxide value, *p*-Anisidine value, oxidation induction time (OIT) by differential scanning calorimeter, and TOTOX value. Overall, synergistic effects were observed by OIT when GG is mixed with RA and TOC in bulk oil. Results showed that the selected antioxidants behaved differently in bulk oil and O/W emulsion.

Tuesday, June 30, 2020

Session Time: 10:25 AM - 12:35 PM

Presentation Time: 11:45 AM - 12:10 PM

Track: Lipid Oxidation and Quality@@@Edible Applications Technology

(3706) Enhanced antioxidant activity of rosemary extracts with phospholipids

Presenting Author: Ernesto M. Hernandez, MS, PhD - Advanced Lipid Consultants

Polyunsaturated fatty acids are highly susceptible to oxidation which greatly reduces their nutritional value and their organoleptic properties as well as flavor and quality of the foods that are fortified with them. Commonly used antioxidants such as tocopherols have generally limited antioxidant activity for highly polyunsaturated edible oils and the amounts of more effective synthetic antioxidants such as TBHQ are regulated to limits of less than 200 ppm. More recently introduced natural antioxidants based on rosemary extracts have been reported to have better antioxidant efficacy and stability when used in edible oils such as vegetable and marine oils. Also lecithin has been reported in the past to be a positive synergist to antioxidants in fats and oils when used combination with both natural and synthetic antioxidants. We evaluated natural

antioxidants rosemary extracts in combination with several phospholipids to produce an antioxidant blend with a superior antioxidant activity when compared to commercial extracts. This presentation will include results on antioxidant activity of various common antioxidant ingredients including tocopherols, ascorbyl palmitate, rosemary extracts and several lecithins in fish oil. Oxidation tests, conducted in an OSI instrument at 80 C and 110 C, confirmed that rosemary extracts-based phospholipid antioxidant blends were more effective antioxidants than tocopherols-based antioxidant blends for anchovy fish oil. Tocopherols stopped been effective at approximately 1000 ppm. On the other hand, the efficacy of rosemary-phospholipid antioxidant blend developed in this work increased proportionally with the concentration at levels higher than 5000 ppm.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Edible Applications Technology

(3705) Development of a Novel Test Strip Which Demonstrates Longer Fry Life of High Oleic Oils

Presenting Author: Susan Knowlton - Corteva Agriscience

Deep fat frying presents a highly oxidative environment to oils during the preparation of fried food. Food service operators encounter difficulties using commodity oils which break down easily in the fryer due to their high polyunsaturated fat content. High oleic oils, on the other hand, are low in polyunsaturated fatty acids and resist oxidation for a longer period, providing food service operators with cost efficient methods to extend fry life without sacrificing product quality. In many European and other countries, the disposal of used fry oil is mandated by legal restrictions which are based on a maximum total polar content of ~25 wt%. Unfortunately, there are no such restrictions in the U.S. nor is there an easy method to measure the total polar content of oil that can be carried out in a restaurant kitchen setting. High oleic oils will benefit from the development of such a test which can readily demonstrate that the oil can be used for a longer period of time along with the added environmental benefits associated with reduced oil usage. This session will discuss the current status of an easy-to-use test strip for measuring the total polar content of fry oils.

Friday, January 1, 2021

Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Health and Nutrition

(3905) Fying Oil Management: Common Practices and Challenges During Food Service/industrial Frying

Presenting Author: Daren K. Coonrod - Flavor Reddy Foods

“Frying oil Management: Common practices and challenges during food service/industrial frying”. Globally, vegetable oil supply is estimated at nearly 200 million metric tons in 2018/2019 (USDA, 2019). Cooking and frying oils are key market segments driving overall consumption. As a result, new approaches and types of oils that create nutritional benefits, sustainability, specific taste profiles and overall cost effectiveness are being explored and deployed in the frying oil segment. A common practice in the quest for healthfulness of fried food products is to remove artificial ingredients, flavors and colors from fried foods. In support this trend, frying oils are developed with a more balanced fatty acid profile with no artificial preservatives all while maintaining flavor profiles of iconic fried food menu items and frying performance. Specialty oils like high oleic canola and more recently high oleic soybean oil are commonly blended with commodity oils to increase monounsaturated, reduce saturated fat and create unique flavor profiles ranging from fried food flavor to more neutral flavor that accentuates the flavor of the food to meet consumer preferences. Blending of oils is also used to balance polyunsaturated fatty acid content to support fry life and address regulatory concerns regarding oils high in polyunsaturated fat content. When combining blending strategies with the removal of antioxidants such as Tertiary Butyl Hydroquinone (TBHQ) and Butylated Hydroxytoluene (BHT) these oils can perform well in industrial frying applications. Each blend strategy requires a vision with national brands to meet consumer demands while balancing cost, performance and flavor.

Friday, January 1, 2021

Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Health and Nutrition

(4035) Are lipid oxidation products consumed in foods toxic? If so, where?

Presenting Author: Karen M. Schaich - Rutgers University

As consumers become increasingly concerned with safety of their food supplies, questions have been raised concerning potential toxicity of lipid oxidation products consumed in mild to moderately rancid foods. Numerous papers in the literature claim that dietary lipid oxidation products cause a myriad of pathological changes, yet others document no effects. Three years ago at AOCS this author presented a first look at this important issue. The present paper provides a more detailed evaluation of whether and how lipid oxidation in foods are toxic, and attempts to

reconcile contradictory reports that are cited repeatedly. Specific attention is given to endogenous detoxification mechanisms that are active throughout the gastrointestinal tract, to serious problems with design and interpretation of experiments testing toxicity of lipid oxidation products, and to dietary components that may modify lipid effects. Changes observed following lipid feeding are considered in the context of normal physiology, metabolism, and detoxification; ordinary expectable responses are differentiated from overt toxicity. Observations are integrated into a proposal for active involvement of dietary oxidized lipids in gastointestinal rather than systemic pathologies.

Friday, January 1, 2021

Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Industrial Oil Products

(3878) Oil Filtration: Critical Part of Oil Quality Management Both Food Service and Industrial Frying

Presenting Author: Andrey Bagreev - Dallas Group of America

During frying, oil degrades due to oxidation, hydrolysis and heat stress, yielding a wide range of oil degradation products which contribute to the taste and the quality of the oil and the food being fried. It is generally recognized that oil filtration is one of the basics of oil quality maintenance. While passive filtration is mainly used for removal of particulates, active filtration by adsorbents eliminates both particulate and soluble degradation products and holds them for removal in filter. Due to the unique structure and surface chemistry, magnesium silicate adsorbents can remove a wide range to total polar materials (TPMs) from frying oil such as free fatty acids (FFA), color compounds and soap. The properties of the synthetic magnesium silicate adsorbents can be further improved to increase FFA adsorption capacity and control polar compounds formation. The chemistry of active filter media, adsorbent dose amount and frequency of filtration play a key role in extending frying oil life. Moreover, using synthetic magnesium silicate as an active filtering aid for frying oil and removing degradation compounds results in higher quality oil and a more consistent frying process. High performance characteristics and excellent filtration properties allow synthetic magnesium silicate adsorbents to be easily used in food service as well as industrial frying applications. This paper presents a summary of recent research on the development of advanced and improved magnesium silicate adsorbents and filter media, and their application for frying oil purification.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Industrial Oil Products

(3862) Walnut Oil Bodies: Oxidative Behavior and Interfacial Reactivity

Presenting Author: Jeanne Kergomard - Institut de Physique de Rennes (IPR)

In seeds, oil bodies (OB) are lipoproteic assemblies that constitute the natural form of storage of triglycerides (TG). The structure of OBs consists of a TG core stabilized by a monolayer of proteins (oleosins) embedded in phospholipids. Despite their high levels of polyunsaturated fatty acids (PUFA), some oleoproteaginous seeds, such as walnut, exhibit high chemical stability against oxidation in addition to nutritional interest. Moreover, the trend towards plant-based food products has increased interest in preserving and understanding the properties of OB. With this in mind, the objective of our study was to investigate walnut OB's oxidative behavior and its interfacial reactivity. Walnut OB were studied either included in a complex matrix (*i.e.* under the form of walnuts "milk"), or isolated in an aqueous dispersion. The walnut OB oxidation was monitored by setting up accelerated storage tests (PV, TBARS). Interfacial behavior was also investigated, using biophysical tools (tensiometry, ellipsometry, atomic force microscopy) for characterization of native dispersed OB in comparison with oxidized OB. Walnuts OB were stable to oxidation on the short term (few days), due to their "assembly effect" and unsaponifiable content. Higher stability of lipid dispersion was observed under "milk" form because of a complex "matrix effect". During interfacial adsorption of objects, OB unfolding and protein-TG domains have occurred. The modification of physical integrity of objects by oxidation have resulted in a different interfacial organization. This study highlights the good stability of OB and their specific interfacial reactivity, opening the way to interesting food applications of these natural lipoproteic assemblies. **KEYWORDS**: walnut, vegetal, oil bodies, oxidation, interfacial behaviour.

Wednesday, July 1, 2020

Session Time: 8:25 AM - 9:45 AM

Presentation Time: 8:30 AM - 8:55 AM

Track: Lipid Oxidation and Quality@@@Phospholipid

(3689) Oxidation kinetics of polyunsaturated fatty acids being esterified into glycerophosphocholine and glycerophosphoethanolamine in dried scallop during storage

Presenting Author: Dayong Zhou - Dalian Polytechnic University

Objective: The difference in oxidative susceptibility of glycerophosphocholine (GPC) and glycerophosphoethanolamine (GPE) and the effects of the same polyphenolic antioxidant on such susceptibility in dried scallop during storage were investigated. Methods Used: Phospholipid (PL) fractions containing GPC and GPE were extracted from dried scallops at selected storage times and their fatty acids were determined. The changes in contents of four

representative PUFAs including α-linolenic acid (ALA), arachidonic acid (AA), eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA) being esterified into GPC or GPE were used to fit kinetic models, which were employed to obtain the reaction rate constant (k) to reflect the oxidation rates of different PL classes. Results: The results indicated that the oxidation of PUFAs (ALA, AA, EPA, and DHA) being esterified into GPC and GPE under two storage temperatures (15 °C and 25 °C) all followed the first-order kinetic model, and GPE had a greater oxidation rate than GPC under the experimental conditions. The natural phenolics effectively inhibited the oxidation of PUFAs being esterified into GPE as well as GPC, and retained the nutritional value of dried scallop after long term storage. By contrast, GPC could more effectively be protected by the polar polyphenolic antioxidant compared with GPE. Conclusions: This finding demonstrates that monitoring of substrate loss and using of kinetic models of PUFAs being esterified into different PL classes may offer insights into further chemical and nutritional studies on food systems that contain complex PL class compositions.

Wednesday, July 1, 2020

Session Time: 8:25 AM - 9:45 AM

Presentation Time: 8:55 AM - 9:20 AM

Track: Lipid Oxidation and Quality@@@Processing

(3841) Enhancing the Shelf Life of Flaxseed Oil by Modifying Oil Manufacturing Processes

Presenting Author: Marc Pignitter, PhD - University of Vienna

Cold-pressed flaxseed oil is rich in omega-3 fatty acids but also highly vulnerable to lipid oxidation. Oil fortification with synthetic and natural antioxidants is a common strategy to overcome the limited shelf life of PUFA-rich flaxseed oil. However, adding antioxidative plant extracts or compounds lead to an increase of costs. Thus, it was aimed to enhance the oxidative stability of flaxseed oil by modifying the manufacturing process to allow efficient transfer of naturally occurring antioxidants from the seeds to the oil. The effect of open and closed process, nitrogen atmosphere, roasting and oil-assisted extraction from press cake on the content of tocopherols and polyphenols in the flaxseed oil as well as on the peroxide value and the shelf life of the oil was evaluated by means of HPLC, LC-MS, titrimetry and Rancimat, respectively. Pressing the seeds in a closed process led to a significant decline of the peroxide value by 76% but did not affect the polyphenol and tocopherol content in the flaxseed oil. Similarly, roasting at 100°C or higher hardly caused any changes with regard to the polyphenols and tocopherols, but a remarkable reduction of the peroxide value by 89.2%. Only oil-assisted extraction of polyphenols from press cake led to a 12-fold increase of the polyphenol concentration in the oil. The polyphenol-enriched flaxseed oil demonstrated to have longer shelf life compared to conventionally-produced flaxseed oils. Low-cost changes of the manufacturing process of flaxseed oil led to an oil with increased amounts of polyphenols and higher oxidative stability.

Tuesday, June 30, 2020

Session Time: 10:25 AM - 12:35 PM

Presentation Time: 10:30 AM - 10:30 AM

Track: Lipid Oxidation and Quality@@@Protein and Co-Products

(3759) Corn Fiber Oil Blends for Improved Frying Oil Stability

Presenting Author: Jill Moser - USDA, ARS, NCAUR

Corn phytosteryl ferulates are composed mainly of saturated phytosterols esterified to ferulic acid. In intermittent frying studies, these compounds were shown to be highly stable antioxidants which reduced oil polymerization, total polar compounds, and tocopherol loss in the soybean oil used for frying. However, these studies were conducted using purified corn phytosteryl ferulates. As a more practical application, the objective of this study was to evaluate the effect of 0.5% and 1% corn fiber oil, extracted from corn wet fiber using hexane and providing 162 to 300 ppm corn phytosteryl ferulates, on frying oil stability during three day studies using intermittent frying of tortilla chips in soybean oil with daily oil replenishment. Oil polymerization was reduced by 50% to 80% with 1% corn fiber oil, and 11% to 60% with 0.5% corn fiber oil. In comparison, 200 ppm tert-butylhydroquinone reduced polymerization by 0 to 22%. Similar effects were demonstrated for total polar compounds, color, and viscosity. In addition, the loss of tocopherols was reduced by 3-40% with 0.5% corn fiber oil, and by 17-47% with 1% corn fiber oil. On average, around 70% of the corn steryl ferulates were retained in the oil at the end of the studies. Low levels of corn fiber oil blended with commodity oils may therefore be a practical source of corn phytosteryl ferulates as frying oil antioxidants.

Wednesday, July 1, 2020

Session Time: 8:30 AM - 9:45 AM

Presentation Time: 8:55 AM - 9:20 AM

Track: Lipid Oxidation and Quality@@@Protein and Co-Products

(3670) The use of synthetic and natural additives in prolonging shelf life of fresh meat preparations

Presenting Author: Henna FS Lu, Master and PhD - Kalsec Europe Ltd

Fresh meat products such as beef burger, meat balls, etc. is a major category of meat retail sales. They are highly perishable, especially when these products are refrigerated (2-5°C) in oxygen semi-permeable packaging. In order to extend the shelf life of fresh meat preparations, both synthetic and natural food additives have been used extensively by meat industry. Shelf life study of various fresh meat preparations including British beef burger and hybrid meat balls (a combination of 50% meat and 50% vegetables) were conducted. Fresh meat preparations containing no additives (control), synthetic or natural antioxidants (treated samples) were stored at chilled condition for several days. The shelf life of fresh meat preparations was monitored through visual observation (mainly color observation) and measurement of secondary volatile oxidation products by SPME-GC/MS. The effect of synthetic food additives such as lactate,

acetate, ascorbate and metabisulphite versus natural additives such as rosemary, vinegar and acerola towards the oxidative stability of fresh meat preparations were investigated. Results showed that inclusion of both natural and synthetic food additives significantly improved the shelf life of fresh meat preparations as compared to control. Fresh meat preparations containing natural food additives showed a comparable performance as synthetic additives in maintaining the color, but with a lower level of oxidation compounds. The finding of these studies showed that natural food additives provided a clean label solution to meat suppliers to improve the shelf life of their fresh meat preparations.

Thursday, July 2, 2020
Session Time: 12:10 PM - 1:00 PM

Presentation Time: 12:35 PM - 1:00 PM

Track: Lipid Oxidation and Quality@@@Protein and Co-Products

(4236) Physical and oxidative stability of high fat omega-3 PUFA delivery oil-in-water emulsions stabilized with modified phosphatidylcholine and oil-water interface characteristics of a model emulsion system using small angle X-ray and neutron scattering techniques

Presenting Author: Charlotte M. Jacobsen - Technical University of Denmark
Presenter: Betül Yesiltas, PhD - Technical University of Denmark

We have investigated the effects of modified phosphatidylcholine (PC) with different alkyl chain lengths (PC_C14 and PC_C16) and covalently attached caffeic acid on the physical and oxidative stability of 70% fish oil-in-water emulsions. Modified PCs were used in combination with sodium caseinate (CAS) and soy-PC. Physical stability of the emulsions improved with increasing concentrations of modified PCs, due to their high surface activity. PC_C14 led to smaller droplets and higher viscosity, whereas PC_C16 had higher protein surface load, which indicated a thicker interfacial layer. Due to the attachment of caffeic acid, which brings the antioxidant near the interface, modified PCs enhanced the oxidative stability of the emulsions compared to emulsions with PC and free caffeic acid. PC C16 led to higher oxidative stability compared to PC C14, mainly explained by provision of a thicker interfacial layer. Additionally, interfacial structure of 70% fish oil-in-water emulsions stabilized with combinations of CAS and soy-PC was investigated using small angle X-ray and neutron scattering techniques. In water, CAS formed aggregates with the hard sphere diameter of 20.4 nm, whereas PC appeared as multilayers whose coherence length spanned from 40 to 100 nm. In emulsion, PC monolayer separated oil and water phases and 80% CAS particles were loosely bound to the interface forming a laterally heterogeneous interface. The distance between aggregated CAS particles in emulsion increased compared to CAS in water. PC multilayers became larger in the presence of oil-water interface compared to PC in water and the bilayers became larger with increasing PC concentration.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Protein and Co-Products

(3630) Lipophilic Peptides Derived from Mung Bean Protein Inhibit Oil Oxidation

Presenting Author: Zhaojun Zheng - Jiangnan University

Oil oxidation poses great threat on food quality, while adding fat-soluble antioxidants is an effective and direct approach to control this. Herein, we investigated the feasibility of mung bean protein hydrolysates on inhibiting the oil oxidation of linoleic acid, pure oil and oil-in-water emulsion as well as their lipophilic peptides on retarding oil oxidation. Our results indicated that enzymatic hydrolysis with ficin, bromelain or alcalase could significantly change the physicochemical properties of mung bean protein, further modifying the hydrophobicity of protein hydrolysates. Also, the protein hydrolysates treated with ficin, bromelain and alcalase showed the strongest DPPH radical scavenging activity with IC50 value of 9.45, 8.67 and 12.17 μg/mL, and metal chelating ability with IC50 value of 7.63, 15.33 and 8.47 μg/mL, respectively. BPH had the strongest antioxidant activity in linoleic acid system, followed by APH. Intriguingly, these three protein hydrolysates could remarkedly prolong the oxidative stability of oil-rich system, such as linoleic acid, sunflower oil, and sunflower oil-in-water emulsion. Subsequently, the lipophilic peptides derived from these three hydrolysates showed not only the surface hydrophobicity, but also excellent ability on inhibiting the formation of primary and secondary products of oil oxidation. Therefore, the lipophilic peptides derived from mung bean protein hydrolysates could be used as potential natural antioxidants on inhibiting oil oxidation.

Friday, January 1, 2021
Session Time: 1:00 AM - 2:00 AM

Presentation Time: 1:00 AM - 2:00 AM

Track: Lipid Oxidation and Quality@@@Protein and Co-Products

(3680) Impact of Natural Antioxidants on Meat and Plant-Based Meat Alternatives

Presenting Author: David R. Johnson - Kalsec

The shelf life of meat products, especially cooked meat products, is limited due to their oxidative stability. In the meat category, consumers are particularly sensitive to what is included in the ingredient list and often expect natural solutions to extend shelf life. Consumers are also making product choices based on the sustainability of ingredients, and this has contributed to the tremendous rise in plant-based meat alternatives. But what limits the shelf life of these products? Even though it looks and tastes like meat, does plant-based meat face the same oxidative stability challenges? To investigate, natural antioxidant strategies were tested in both meat and plant-based meat alternatives. In both cases, 2000 ppm rosemary extract was applied to the protein system, the samples were cooked, and then stored refrigerated. Analysis by gas chromatography (headspace aldehydes) showed a protective effect of rosemary extract in meat products over shelf

life storage. A combination of natural antioxidants (rosemary and green tea), further increased stabilization of cooked meat products. These results were then positively correlated by a trained sensory panel identifying an increase in warmed-over-flavor in the control meat treatments. When testing plant-based meat alternatives, headspace aldehydes did not increase over the storage of the samples, both with and without antioxidants. Results suggest that the production of other off flavors, possibly associated with proteins, are responsible for limiting shelf life. Overall, the research emphasizes that understanding the matrix, and source of oxidizable lipids, is key in designing antioxidant strategies to extend product shelf life.