18th AOCS Latin American Congress and Exhibition on Fats, Oils and Lipids
8–11 October 2019
Bourbon Cataratas Convention & Spa Resort | Foz do Iguaçu, Brazil

Abstracts are published as submitted.

Los resúmenes se publican tal como fueron presentados.

Os resumos foram publicados idênticos aos submetidos.

Wednesday, October 9, 2019

Crushing

Session Chairpersons: Héctor Autino, Bunge South America & ASAGA, Argentina; and Anibal Demarco, Desmet Ballestra, Argentina

40 años de Optimización de Procesos, del románticismo a los sistemas inteligentes. Carlos V. Caruso, *Oleaginosa Moreno, Argentina*

Se realiza una síntesis de los procesos de molienda de oleaginosos, en el área de extracción por solvente. Se desarrollan los puntos que se consideran mas importantes, en el proceso de mejora y optimización, en los últimos 40 años. El objetivo final es promover el análisis de las operaciones actuales, sobre bases científicas y de seguridad industrial.

Tratamiento alternativo de gomas. Desaceitado. Anibal Demarco, *Desmet Ballestra, Argentina*

The crude oil from the solvent extraction process contains water soluble components, primarily comprised of phospholipids, which need to be removed from the oil to enable minimum precipitation and settling during oil transport and long-term storage. The water degumming process involves adding water to the crude oil, hydrating the water-soluble components, and then removing the majority of the water-soluble components via centrifugal separation. The light phase after centrifugal separation is the crude degummed oil, and the heavy phase after centrifugal separation is a combination of water, water-soluble components and entrained oil, collectively referred to as “wet gums”. The composition of the wet gums produced by the water degumming process is approximately 50% moisture, 35% water soluble content, 15% entrained oil and trace meal fines. There is an oil loss of 0.5-1.0% of the crude soybean oil during the centrifugal separation due to some entrained oil passing with the wet gums. Enzymatic Gums Deoiling is a patented solution that can reclaim a portion of the entrained oil from the wet gums and simultaneously convert some of the phospholipids into diglycerides and fatty acids, also recoverable with the oil.

Preparacion: optimizacion de planta // Preparation: Plant Optimization. Anibal Demarco, *Desmet Ballestra, Argentina*

Abstract not available

Sistemas de limpieza para la industria de semillas oleaginosas. Rafael Grabois, *PROGLOBAL, Argentina*

Sistemas de limpieza para la industria de semillas oleaginosas El objetivo de la presentación es concientizar sobre la importancia de la prelimpieza en plantas de procesamiento de semilla. Una vez realizado, se establecerá un lenguaje común para definir los potenciales problemas que existen en este tipo de limpiezas y cuáles podrían ser las soluciones. Finalmente, se volcaran esas herramientas o soluciones a un process flow diagram para poder comprender la limpieza en su conjunto. También se analizarán alternativas, ventajas y desventajas de estos sistemas. Esta presentación será realizada con un back up de muchos años de experiencia realizando la plantas de limpieza más grandes del mundo.

Sistemas de descascarado aplicados a soja & girasol. Rafael Grabois, *PROGLOBAL, Argentina*

Abstract not available

Functionality in Food

Session Chairpersons: Elena Dibildox Alvarado, Universidad Autónoma de San Luis Potosí, Mexico; and Maria Lidia Herrera, University of Buenos Aires, Argentina

Nanoemulsions stabilized by proteins: structure and physical properties.
Nanoemulsiones estabilizadas con proteínas: estructura y propiedades físicas. Maria L. Herrera, *University of Buenos Aires, Argentina*

Nanoemulsiones estabilizadas con proteínas: estructura y propiedades físicas Una nanoemulsión es un sistema bifásico que contiene una fase dispersa con gotas de radio menor a 100 nm. Las nanoemulsiones se pueden preparar por métodos de alta o baja energía. Cuando se estabilizan con emulsificantes de moléculas pequeñas el tamaño de gota es en general más bajo que utilizando otros estabilizantes. Las nanoemulsiones de proteínas requieren en general alguna etapa más de síntesis para alcanzar el rango nano. Las proteínas de leche se han empleado extensamente en sistemas convencionales porque se adsorben en la superficie de las gotas y forman una película fuerte que ayuda a evitar la agregación. Con el método de síntesis adecuado también permiten preparar nanoemulsiones. El pequeño tamaño de gota que se alcanza les confiere a los nanosistemas una estructura más homogénea que la que poseen los sistemas convencionales, lo que trae aparejado algunas ventajas sobre los mismos como por ejemplo tener gran estabilidad física y no verse afectado ni por la desestabilización por gravedad ni por la agregación. Dependiendo de la formulación, las nanoemulsiones pueden ser estables por meses. Las nanoemulsiones poseen otras ventajas adicionales como aumentar la biodisponibilidad de las sustancias encapsuladas en la fase dispersa y ser transparentes. La aplicación de nanotecnología al campo de alimentos puede ser una herramienta valiosa para modificar propiedades macroscópicas del producto como textura, transparencia y vida útil de

estantería. En esta presentación se mostrarán ejemplos de nanoemulsiones estables y se correlacionarán sus estructuras con las propiedades físicas.

Hydrogellation in the structuring of emulsions W-high oleic palm oil: rheology and microstructure. Elena Dibildox Alvarado, Adriana Arellano, and Jaime D. Pérez-Martínez, *Universidad Autónoma de San Luis Potosí, Mexico*

The effect of the concentration (0.6, 1 and 2%) of the hydrocolloids xanthan gum, low methoxyl pectin and carboxymethylcellulose (CMC) as structuring agents in hydrogels and in their hydrogenated emulsions was evaluated. The structuring level was monitored through rheological analysis (oscillatory and rotational) and by bright field microscopy. Additionally, the mechanical stability of water in high oleic palm oil emulsions (W/O) was observed during 30 days of storage. The presence of Xanthan gum and Pectin in concentrations of 1 and 2%, led to a better water structuring and greater stability of the hydrogels (elasticity >500 Pa and yield stress >50% of strain), this in comparison with the hydrogels of CMC, where stable gels were not formed at any concentration. In addition, the microstructure of the W/O emulsions (40/60) hydrogellated with xanthan gum and pectin at 0.6%, revealed a low stability (because of coalescence), due to the heterogeneous distribution of the hydrogel droplets inside the emulsion, as well as droplet sizes above 45 µm. However, concentrations of 1 and 2% of both hydrogelants, generated emulsions of high mechanical stability without significant changes in the distribution of the droplets and of a size below 20 µm, so these systems could be suitable for food applications.

Deviation from the polar paradox of some antioxidants in O/W emulsions. Laura A. López-Martínez[1], Alejandro Rocha-Uribe[2], Fernanda Peyronel[3], and María Zenaida Saavedra-Leos[4], *[1]Coordinación Académica Región Altiplano Oeste de la Universidad Autónoma de San Luis Potosí, Mexico; [2]Facultad de Ciencias Químicas, Universidad Autónoma de San Luis Potosí; [3]Dept. of Food Science, University of Guelph, Canada; [4]Coordinación Académica Región Altiplano, Universidad Autónoma de San Luis Potosí, Mexico*

Deviation from the Polar Paradox of some Antioxidants in O/W Emulsions The polar paradox is a theory that was proposed in the 1990s to explain the relationship between the polarity or hydrophobicity of antioxidants and their efficacy. Accordingly, hydrophilic antioxidants are more effective in hydrophobic media, such as bulk oils, than their more hydrophobic counterparts, while hydrophobic antioxidants are more active in more hydrophilic systems, such as emulsions. We studied the concentration of antioxidants (gallic acid, GA; propyl gallate, PG; ascorbyl palmitate, AP; and α-tocopherol, TC) present in the aqueous, oil and interface phases in a 79% oil-in-water emulsion rich in n-3FA and stabilized with either Tween 65 or Tween 80. The antioxidant protection against oxidation products was the highest for AP and the lowest for TC, with AP > GA > PG > TC. The highest hydrophobicity antioxidant, TC, was the least active in this emulsion, behavior that deviates of that was expected following the polar paradox. This behavior aligns better with the theory of cut-off effect, a theory that states that the antioxidant protection depends on : its concentration, its electrical charge, and its aliphatic chain length. This work shows the importance of using nonionic surface active agents (Tween) together with the antioxidants to effectively provide antioxidant protection. Experimental results showed that as the antioxidant concentration in the interface decreased, the peroxide value increased indicating the lack of effectiveness of the antioxidant.

Antioxidants in the interface were responsible for ~ 56 % of the protection against as noticed by the p-anisidine value measured.

Parámetros de oxidación de oleogeles de diferentes aceites con cera de carnauba. Bruno A. Irigaray[1], Natalia Martinez[2], Jimena Lázaro[1], Nadia Segura[1], and Iván Jachmanián[2], *[1]Facultad de Química, Uruguay, [2]UdelaR, Uruguay*

Parámetros de oxidación de oleogeles de diferentes aceites con cera de carnauba. Los oleogeles son actualmente una alternativa moderna para la preparación de materiales grasos con características fisicoquímicas adecuadas para su utilización en la industria alimentaria. Por lo tanto, es de interés conocer la influencia del agregado de agente estructurante en la estabilidad oxidativa del oleogel. El objetivo de este trabajo fue estudiar la estabilidad oxidativa de oleogeles preparados con tres aceites diferentes: girasol común (SFO), girasol de alto oleico (HOSFO) y chía virgen (CHO) con cera de carnauba (CRW) en diferente concentración (3 y 7%). La estabilidad oxidativa se determinó mediante enranciamiento acelerado monitoreado por calorimetría diferencial de barrido (DSC Shimadzu 60A-Plus) en modalidad isotérmica, bajo atmósfera de oxígeno. A partir de los períodos de inducción obtenidos se determinó las constantes de velocidad del proceso de oxidación (k, en min-1) considerando una cinética de orden 1. Se determinó el contenido de tocoferoles en los aceites mediante HPLC utilizando un detector de fluorescencia. El CHO fue el aceite que presentó el mayor contenido de tocoferoles (1694 ppm), mientras que el SFO y el HOSFO presentaron niveles similares (758 y 700 ppm, respectivamente). El CHO presentó una constante de velocidad a 140°C (k140C) de 0.12 min-1 mayor a la k140C del SFO (0.036 min-1) y a la k140C del HOSFO (9.1x10-3 min-1). Sin embargo, los oleogeles con 3 y 7% de CRW y CHO mostraron un incremento de la k140C con valores de 0,36 min-1 y 0,21 min-1 respectivamente. Por otra parte, la k140C de los oleogeles de 3% y 7% de CRW con SFO fue de 0.030 min-1 y 0.037 min-1. Estos valores no presentaron una diferencia significativa. Los valores de k140°C para los oleogeles formados con 3 y 7% de CRW con HOSFO tampoco presentaron diferencias significativas (9.5x10-3 y 1.0x10-2 min-1, respectivamente). En conclusión, la adición de CRW como estructurante contribuyó de manera diferente en la estabilidad oxidativa de los oleogeles formados donde el grado de insaturación del material graso utilizado fue determinante.

From fats to oleogels: Evolution and new perspectives for healthiness in the food industry. Marcela Stahl and Ana Paula B. Ribeiro, *University of Campinas, Brazil*

Evolution and new perspectives for healthiness in the food industry Controversial issues about the role of trans fatty acids in health, intensely discussed since 1990, have led to progressive changes in the legislation of several countries. In response, the industry opted for the replacement of trans fat by developing fat bases with functionality and economic viability equivalent to partially hydrogenated fats, leading, however, to a substantial increase in the content of saturated fatty acids in foods. At present, the lipid science aims to define alternatives to a question widely discussed by health organizations in the world, which consists of reducing the saturated fat content in processed foods. In this scenario, lipid matrices must have low content of saturated fatty acids and absence of trans fatty acids, which are associated with an increase in the risk of cardiovascular diseases. In parallel, in a technological and commercial approach, oils and fats must exhibit structural and sensorial characteristics appropriate to the production and acceptability by the consumer. The reduction of saturated

fat in lipid bases for industrial use is not feasible using conventional lipid modification processes alone, since the potential for reducing the levels of saturated fatty acids by these means is significantly limited. In contrast, the use of organogels, lipid systems characterized by the incorporation of specific structuring agents to polyunsaturated oils, has been highlighted as a potential alternative to obtain fats with reduced levels of saturated fatty acids and properties compatible with food applications. The objective of this work is to present an extensive review on the development, characterization of lipid organogels, as well as their application in food.

Functionality in food

Session Chairpersons: Elena Dibildox Alvarado, Universidad Autónoma de San Luis Potosí, Mexico; and Fernanda Peyronel, Dept. of Food Science, University of Guelph, Canada

Cristalización de fases grasas elaboradas con aceite de salvado de arroz completamente hidrogenado: análisis cinético. Nicolas Callejas and Iván Jachmanián, *UdelaR, Uruguay*

Se realizó el estudio de la cinética de la cristalización de mezclas (M) de aceite de salvado de arroz (RBO) con el mismo aceite completamente hidrogenado (FHRBO) en diferente proporción y de sus productos de interesterificación (P). Para ello se determinó la evolución del contenido de sólidos (SFC) durante la cristalización isotérmica de las muestras dispuestas a 25°C en un equipo RMN (Bruker pc120 minispec). Se estudió un rango de concentraciones de 10 a 90% de FHRBO, las interesterificaciones se realizaron mediante catálisis enzimática (Lipozyme TL-IM) y los parámetros determinados fueron: período de inducción (τ), máximo contenido de sólidos (SFCmáx) y la constante de velocidad (k) y exponente (n) correspondientes al modelo de Avrami. El aumento en la proporción de FHRBO en las mezclas produjo una gradual disminución en el valor de τ, desde 8.8 min hasta 1.3 min, correspondientes a M90% y M10%, respectivamente. Esto estaría indicando una mayor velocidad de formación de núcleos en la fase grasa a medida que aumenta el porcentaje de FHRBO, lo que resulta coherente con el incremento en la concentración de triglicéridos saturados. De la misma manera, la velocidad de crecimiento cristalino fue mayor en las mezclas con mayor contenido de FHRBO, lo que se manifestó por un mayor valor de constante de velocidad: k = 0.0006 y 0,035 min-1 para M10% y M90%, respectivamente. En los productos se observó una tendencia similar de τ y k con el porcentaje de FHRBO. Asimismo, los valores de τ de cada producto fueron mayores que los de su mezcla de partida, mientras que los de k fueron menores. Esto indica que la interesterificación enlenteció tanto la etapa de nucleación como la de crecimiento cristalino, lo que es coherente con la disminución de triglicéridos saturados como resultado de este proceso. En relación al exponente de Avrami (n) en ningún caso se obtuvieron números enteros, lo que estaría indicando cambios en la morfología durante la cristalización. Los resultados obtenidos sugieren que los productos cristalizaron mediante una cinética más conveniente que las mezclas de partida a los efectos de su aplicación como fases grasas para shortenings o margarinas.

Co-crystallization of fully hydrogenated milk fat and high oleic sunflower oil: a compatibility study. Mayara S. Queirós, Rodolfo L.S. Viriato, Ana Paula B. Ribeiro, and Mirna L. Gigante, *University of Campinas, Brazil*

The objective of this work was to evaluate the capacity of co-crystallization of the fully hydrogenated milk fat (FHMF) with high oleic sunflower oil (HOSO) in the proportions 100:0

(control); 90:10; 80:20; 70:30; 60:40; 50:50. The lipid bases were evaluated as for fatty acids composition, melting point, solid fat content and compatibility diagram. The addition of HOSO (88.68 unsaturated fatty acids) to FHMF resulted in lipid bases with significant reductions in the saturated fatty acid concentration, solid fat content at different temperatures and the melting point. This behavior is mainly related to the increase of triunsaturated triacylglycerols from HOSO (OOO and OOL). The melting point decreased from 46 to 40 °C, in the lipid bases 100:0 and 50:50, respectively. However, the difference in composition and melting point between FHMF and HOSO did not impair total compatibility and formation of continuous solid solutions. This compatibility is due to the solubility of triacylglycerol molecules in the solid state, suggesting a co-crystallization between the components. Thus, the physical properties resulting from the chemical composition of FHMF enabled the modulation of crystallization processes in the formulations studied, ensuring that the HOSO crystals were deposited in the crystalline FHMF nuclei while the uncrystallized phase was trapped in the crystalline network. These results suggest the potential of application of these lipid bases in technological applications where thermal and mechanical resistance are necessary to prevent the exudation of oil or to promote the stability of the product during processing, storage or consumption.

Impact of storage conditions on antioxidant efficacy. Lan Ban, Joan Randall, Marie Shen, and Chandra Ankolekar, *[1]Kemin Food Technologies, USA; [2]Kemin Industries Inc., USA*

Oxidative stability of oils can be measured by accelerated studies such as OSI, Schaal oven testing or by using a comprehensive storage tests under ambient conditions following real time chemical and sensory analysis. Most of the published literature have depended on accelerated conditions for screening of antioxidant efficacy for their relative ease and quickness. However, are they reliable tools for understanding antioxidant behavior? We hope to answer these and other questions with OSI, PV, Total carbonyls and EPR analysis of oil treated with plant extracts as well as synthetic antioxidants by comparing them under accelerated as well as ambient conditions. In this study four ingredients were tested: TBHQ, rosemary extract, mixed tocopherols and oil-soluble green tea extract. Chemical analysis included PV, Total carbonyls, EPR and antioxidant surplus analysis of three common vegetable oils: canola, palm and soybean oil. Results showed us that the trends in antioxidant efficacy were very similar. Rosemary extract although does not perform well in accelerated conditions, showed excellent resistance to oxidation whereas performance of tocopherol was the same in both accelerated or ambient conditions. Performance of oil-soluble green tea improved under ambient conditions. Dose response observed in accelerated studies were observed under ambient storage conditions as well. Accelerated studies can be used as a screening tool but it takes ambient storage studies for establishing the true efficacy of an antioxidant. It is recommended to run ambient storage studies when optimizing antioxidant levels for shelf life.

Protection of frying oil with natural sources of antioxidants blends. Lan Ban[1] and Chandra Ankolekar[2], *[1]Kemin Food Technologies, USA; [2]Kemin Industries Inc., USA*

Deep frying has been known since ancient history and brings about an attractive change of flavor, texture and color in the food. In the last decade, commercial frying has become a billion-dollar industry worldwide. This industry not only includes the oil and fat used for frying, but also the fried foods that are sold as a result. However, deep-frying also leads to undesired chemical and physical changes that affect both the quality of the deep-frying medium and the

fried food. Traditionally, synthetic antioxidants like TBHQ and citric acid are used to stabilize frying oil. Alternative ingredients derived from natural plant sources are starting to be used for frying oil stabilization because they are more desirable from a consumer perception, but also due to the improvement they present in terms of heat stability. For this study, different molecules were combined and tested: TBHQ, citric acid, mix of tocopherols, rosemary extract and oil-soluble green tea extract. Antioxidants were applied in frying palm oil and frying rapeseed oil. Analysis included OSI in different temperatures and frying cycles, total polar compounds and anisidine value. Studies showed better performance from natural blends compared to synthetic mixtures. In summary, results indicated that there is a great potential of improving life cycle of frying oil when using natural sources molecules. This trend would benefit not only the food manufacturer, due to process improvement, but also the final customer, who would receive cleaner label products.

Palm oil-based trans fatty acids free margarine that is stable from temperature of 5°C to 35°C. Sivaruby Kanagaratnam, Noor Lida Habi Mat Dian, Rafidah Abd Hamid, Wan Rosnani Awang Isa, Nur Haqim Ismail, and Norazura Aila Mohd Hassim, *Malaysian Palm Oil Board, Malaysia*

Two types of spread margarines are currently produced and marketed in Malaysia, which are categorized as refrigerated and non-refrigerated margarines. The key characteristic of refrigerated margarine is that it should be spreadable straight from the refrigerator (4°C) and should not oil out at usage temperature of 20°C to 25°C. Non-refrigerated margarines on the other hand, has higher slip melting point than refrigerated margarine as this category of margarine is stored (without refrigeration) and used between temperature of 20°C and 35°C Generally non-refrigerated margarines turn hard, in some cases become brittle and cracks when stored at temperatures below 10°C. These two types of margarine require two different type of oil blend to cater for the different application temperatures. This study aimed to produce margarine blend that is suitable to be used between the temperatures of 5°C to 35°C. Three palm oil-based solid fractions (POSF) of IV 30, IV 20, and IV 10 were selected and evaluated in binary blends of sunflower and POSF. The blending ratios of sunflower oil to POSF were 97.5:2.5, 95.0:5.0, 92.5: 7.5 and 90.0:10.0 (w/w). The perfector pilot plant was used to texturize the emulsified fat blends and the characteristics of the texturized fats were determined. Based on the solid fat content and stability binary blends of sunflower oil with POSF IV 10 at ratio of 92.5:7.5 and 90:10 were able to provide acceptable blends which supports the requirement of margarine that is stable from temperature of 5°C to 35°C. The other binary blends were not acceptable.

Health and Nutrition

Session Chairpersons: Ernesto Hernández, Advanced Lipid Consultants, USA; and José Alberto Gallegos Infante, TecNM/ITD, Mexico

Challenges to increasing healthy lipids in the food supply. Eric A. Decker, *Dept. of Food Science, University of Massachusetts, USA*

Challenges to increasing healthy lipids in the food supply Numerous organizations around the globe are encouraging the increased consumption of unsaturated and omega-3 fats and discouraging the consumption of solid fats and trans fatty acids. Producing a food supply

that meets these recommendations can be challenging as fats not only contributes to nutrition but are also instrumental in the structure, mouth feel, appearance and stability of foods. In order to help consumers meet dietary guidance, it will be critical to develop technology to development high quality, affordable and nutritious foods. This talk will summarize how the interface of nutrition and food science can be leverage to create solid fats with high levels of unsaturated fatty acids, utilize omega-3 oils that do not negatively impact food quality, increase the concentration of beneficial fatty acid and control the oxidative stability of unsaturated fatty acids to maintain quality and shelf-life.

Some things we learned from the Omega-3 Index. Clemens von Schacky, *University of Munich, Germany*

The Omega-3 Index is % EPA&DHA in erythrocytes, determined with the specific analytical method "HS-Omega-3 Index®". The Omega-3 Index is representative for EPA&DHA in all human cells so far analysed. Humans with an Omega-3 Index 19% have not been found. Intake of EPA&DHA can increase the Omega-3 Index, but with a very large inter-individual variability. Bioavailability of EPA&DHA is complex. Epidemiology using the Omega-3 Index found that total mortality and adverse cardiovascular events correlate inversely with the Omega-3 Index, more closely so than with intake of EPA&DHA. The same is true for premature birth, major depression, impaired cognition, and other frequent health issues. Intervention trials found improvements in e.g. cardiovascular or cognitive parameters to correlate with the Omega-3 Index. With the Omega-3 Index, issues in design and execution of many large intervention trials were identified that are responsible for inconsistent results and, hence, neutral results of pertinent meta-analyses. Omega-3 Index-based intervention trials are currently ongoing and will provide a clearer picture of the effects of EPA&DHA. According to the regulatory authorities, EPA&DHA are safe and well tolerated up to 5 g/day (EFSA) or 3 g/day (FDA). An Omega-3 Index below the target range of 8-11% is frequently found in many developed countries, but far less frequently in Japan or South Korea. Therefore, a good case can be made that an Omega-3 Index below the target range represents a deficit that needs to be counterbalanced by increasing intake of EPA&DHA in a targeted manner.

Benefits of human milk lipids in early life and their potential impact on later life (metabolic) health. Sandra Einerhand, *Einerhand Science & Innovation BV, Netherlands*

Benefits of human milk lipids in early life and their potential impact on later life (metabolic) health Human milk (HM) fat consists of a unique fatty acid mixture present in a fat droplet that is coated by milk fat globule membranes (MFGM) containing numerous complex lipids. Historically, and for good reasons, a lot of attention has gone out to poly-unsaturated fatty acids found in HM. However, here we provide an overview of the latest science on β-palmitate, an abundant structured lipid, and on the large fat droplets coated with MFGM. The digestion and absorption of β-palmitate in infants have been extensively studied. These studies indicated that infant formula with a high β-palmitate content improved dietary fat and calcium absorption. These effects have been associated with improved bone strength, an altered gut microbiota and reduced crying in infants. Furthermore, studies in rodents showed that a diet high in β-palmitate reduced gut inflammation in a colitis model, and altered tissue endocannabinoid concentrations, indicating that β-palmitate may induce key immune and neurodevelopmental health effects that need to be further explored in human intervention

trials. Milk fat globular membrane coating of HM fat and its 3 D structure only recently received a lot of attention from the scientific community. Traditionally, MFGM was absent in infant formulas, but manufacturers are starting to introduce MFGM into formulas to match the composition of HM and because several intervention trials demonstrated effects of supplementation on both neurocognitive development and defense against infections. Furthermore, emerging science indicated that the size and coating of the fat droplet matters. In a preclinical model, large-phospholipid coated fat droplets that mimic HM fat prevented fat accumulation and improved metabolic profile in adulthood, indicating that exposure to an altered dietary lipid structure in early life may be a key determinant of later life metabolic health. Safety of this new concept has recently been demonstrated in infants and an efficacy study is currently ongoing. This efficacy study tests the assumption that the altered lipid structure may result in a healthier growth and body composition development pattern highlighting the role of lipid structure in infant nutrition.

Specialty oils and co-products from Brazilian native nuts: their applications in foods, and their importance in human nutrition and health. Jane Mara Block, *UFSC, Brazil*

Specialty oils and co-products from Brazilian native nuts: applications in foods, and their importance in human nutrition and health The consumption of nuts has been associated with beneficial effects on health, especially the prevention of chronic non-communicable diseases. Native nuts from the Brazilian Amazon forest such as sapucaia (Lecythis pisonis), chichá (Sterculata striata), pracaxi (Pentachletra macroloba) and munguba (Pachira aquatica) are rich in oil, nutrients and bioactive compounds. Using sustainable technologies it is possible to obtain specialty oils and co-products such as the press-cake and shells from these nuts. The nutritional and chemical composition, functional characteristics and antioxidant capacity of such raw materials are not well known yet. The oils have high levels of mono and polyunsaturated fatty acids, tocopherols and sterols. The partially defatted cake are rich in phenolic compounds and it can be used to produce nuts flour and nut-based nondairy substitutes for milk. Extracts rich in phenolic compounds obtained from the nuts shells presenting high antioxidant activity may also add value to these co-products. The study of the underutilized Brazilian native nuts and their co-products is an important iniciative to encourage the sustainable production, the consumption and their use for the food, pharmaceutical and cosmetics industries.

Modificación del perfil graso de leche caprina mediante inclusión de aceite de soja o girasol en el suplemento. Cecilia Dauber[1], Gabriela Casarotto[2], Fabiana Cabrera[2], Adriana Liscano[2], Gabriela Vicente[2], Paola Veliz[2], Natasha Barrandeguy, Alejandro Britos[2], Silvana Carro[2], and Ignacio Vieitez[3], *[1]Facultad de Química. Universidad de la República, Uruguay; [2]Facultad de Veterinaria. Universidad de la República, Uruguay; [3]UdelaR, Uruguay*

El objetivo del presente trabajo fue estudiar la modificación en el perfil lipídico de la leche caprina, por inclusión en la dieta de aceites vegetales ricos en ácidos grasos poliinsaturados. El interés particular fue producir un aumento en el contenido de ácido linoleico conjugado (CLA) y ácido transvaccénico (TVA), y a la vez disminuir la proporción de grasa saturada.

El estudio se realizó con 27 cabras de raza Saanen (PV= 55.1 ± 8.0 kg) en el primer tercio de lactación, separadas en tres grupos iguales (n=9) y suplementadas durante 50 días con 750 g diarios de 3 concentrados con 0% (control), 7.5% de aceite de soja o 7.5% de aceite de girasol.

Se realizaron muestreos periódicos de leche, determinándose contenido graso por Rose Gottlieb y perfil lipídico por cromatografía de gases.

El contenido de grasa láctea total no se vio modificado por las dietas. El contenido de TVA aumentó de 1.5 a 2.6 y 2.7% para soja y girasol respectivamente ($p<0,01$), mientras que el de CLA presentó un aumento de 0.6 a 0.8% para ambos grupos ($p<0,01$). En las muestras de leche provenientes de las cabras alimentadas con las dietas modificadas se observó una disminución en la relación saturados/insaturados resultando en una disminución del índice aterogénico, lo que indica un menor riesgo de sufrir enfermedades cardiovasculares.

De acuerdo a estos resultados, la inclusión de aceite de soja o girasol en la dieta de cabras en lactación podría constituir una alternativa viable para aumentar el aporte de ácidos grasos con propiedades beneficiosas para la salud en la leche.

Structured lipids and their importance in human nutrition and health. Ernesto M. Hernández, *Advanced Lipid Consultants, USA*

The modification of lipids and phospholipids can be accomplished by interesterifying and transesterifying triacylglycerols with other lipids, phospholipids and bioactive compounds. Some of the main applications of structured lipids (SLs) include functional foods and new nutritional supplements. This paper will review updated technologies on the use of enzymes for the production of functional SLs using lipase- and phospholipase catalyzed interesterification. Examples of SL in foods are mixtures of long-chain and short-chain fatty acids for low calories and special diet products. For example, structured medium chain triglycerides (MCT) can be obtained from coconut oil fractions through interesterification and fractionation. Another example includes the use of interesterification for the production of lipid delivery systems in nutritional supplements, cosmetics and pharmaceutical products. Bioactive structured phospholipids synthesized using phospholipases (A1, A2, C and D) and lipases will also be included. These enzymatically catalyzed reactions can be conducted using immobilized phospholipases and combination with lipases to produce phospholipids with specific bioactive properties. This paper will review techniques on synthesis and applications of bioactive structured phospholipids such as enzymatically enriched PLs with n-3 fatty acids (Linolenic, EPA and DHA), CLA, omega 7 fatty acids as well as the synthesis and applications of phospholipids containing bioactive sterols catalyzed with phospholipase D.

Processing and Refining

Session Chairpersons: Roberto Berbesi, Oil-Dri Corporation of America; and Leon Pablo Espinosa, Desmet Ballestra NA, Inc., USA

Buenas prácticas en el manejo de aceites de origen vegetal, sebo vacuno y aceite de palma. Federico Corvetto[1] and Eliana S. Morales[2], [1]*South American Trading LLC, USA;* [2]Prodalsa SA, Argentina

Buenas prácticas en el manejo de aceites de origen vegetal, sebo vacuno y aceite de palma Parámetros a tener en cuenta para conservar la calidad de dichos productos en el transporte y almacenamiento, en el corto, mediano y largo plazo. Condiciones físicas y químicas del producto a tener en cuenta. Condiciones previas y posteriores de los tanques de almacenamiento y tuberías de transporte y descarga, referidas a materiales, políticas de

limpieza y mantenimiento. Nuevas tecnologías y equipamiento aplicables.

Lactic acid in enzymatic degumming and other applications. Rafael Contador[1], Danilo M. Lima[2], Florivaldo Galina[2], Lucas Klettenhofer[2], Hubertt Elias[2], and Fernanda Faria[2], *[1]Corbion Purac Ltda, Brazil; [2]brprocess, Brazil*

Lactic acid in enzymatic degumming and other applications Citric and phosphoric are the most commonly acids used on refining of vegetable oils. Typical applications for those chemicals are degumming, antioxidant, and interesterification, besides biodiesel applications. Lactic acid, another organic acid with chelating capabilities, which was used for some of those applications in the past, was tested on a range of possible applications in laboratory. It has been possible to find a very positive synergy of enzymatic degumming with phospholipase A1 and the use of lactic acid which resulted on publication of two patents (already granted). Lactic acid was used for acid conditioning of phospholipids, and sodium carbonate, instead of hydroxide, for pH adjustment in the range of 5.5 as PLA requires. The use of sodium carbonate leads to lower generation of soaps compared to hydroxide, what allows better separation and reduction of final phosphorous content. Lactic acid has other advantages over citric. Lactates are water-soluble, what avoids salt precipitates on heaters and centrifuges (citrates), better OPEX and robustness on P reduction. This setup has been proven on industrial scale and three refineries in Brazil are using lactic acid instead of citric for enzymatic degumming, with a clear expected growth. Around 30% of the soybean oil refined in Brazil is currently processed using Phospholipase A, with an increasing rate of new players. This work will show the benefits of lactic acid due to its unique advantages in enzymatic degumming. Its value proposition on interesterification and biodiesel washing has been developed in laboratory and industrial scales, with presentable results.

New enzymatic processes improve the yield in alkaline refining of vegetable oils. Per Munk Nielsen[1], Hans Christian Holm[1], Andersom Cattoni[2], and Danilo M. Lima[3], *[1]Novozymes A/S, Denmark; [2]Novozymes Latin America Ltda, Brazil; [3]brprocess, Brazil*

Use of enzymes in the degumming process is accepted in the vegetable oil processing. The effect of the enzymes is first and foremost to obtain a highest possible yield, but also to help assuring a good quality of the refined oil. The known processes use different types of enzymes. In the water degumming process extra yield is obtained by a treatment with phospholipase C/A, and in acid refining use of phospholipase type A followed by physical refining is the typical solution.

In the alkaline refining process, the phospholipids are removed from the oil by a water degumming and the caustic treatment. This comes with a yield loss. We have identified a new way of operating the alkaline refining process by integrating a phospholipid hydrolysis into the process line. It has been possible to design an alkaline refining process where the enzyme treatment with phospholipase A or C fits in, and results in a significant yield increase, with different requirements of CAPEX and OPEX. The process includes following steps: an acid chelating, pH adjustment, enzyme reaction, alkaline treatment, separation, and washing. The processes will be presented with the documentation for the yield improvement compared to a typical chemical refining process.

Nano neutralization, aplicaciones practicas. William Blake Hendrix, *Desmet Ballestra North America Inc., USA*

Normalmente los aceites insaturados son procesados a través del proceso de refinación caustica, proceso que por su naturaleza permite la formación de jabones a través del ataque de la soda con los ácidos grasos y el aceite neutro. Este proceso normalmente a través del uso de temperaturas moderadas (85ºC), mezcladores estáticos y dinámicos mejora el proceso de reacción. La tecnología de neutralización es una de las pocas que ha tenido muy pocos avances en las ultimas décadas. El procesador de aceites vegetales siempre enfocado en un proceso eficiente ha mejorado sus rendimientos, pero no había llegado una tecnología que permitiera realmente marcar una gran diferencia en los resultados. La aparición del Nano Reactor (Tecnología patentada) ha permitido lograr un proceso mas eficiente disminuyendo el uso de reactivos como acido fosfórico en un 90% y soda caustica en un 30% como mínimo, y en cuanto al rendimiento mejoras en un mínimo de 02%, pero esperado por encima de 0.4%. En esta presentación se mostrara como funciona esta tecnología, como es su fácil instalación en su planta existente o como hace parte de una nueva instalación; también se mostrara los potenciales ahorros por no usos de agua de lavado y/o sílice para la eliminación de jabones, demostrando que es una tecnología que todo procesador de aceite debe tener.

Nano Neutralization, practical applications. William Blake Hendrix*, *Desmet Ballestra North America Inc., USA*

Normally unsaturated oils are processed through the caustic refining process, a process that by its nature allows the formation of soaps through the attack of soda with fatty acids and neutral oil. This process normally use of moderate temperatures (85ºC), static and dynamic mixers improves the reaction process. Neutralization technology is one of the few that has had very little progress in the last decades. The vegetable oil processor, always focused on an efficient process, has improved its yields, but a technology that really made a big difference in the results had not arrived. The apparition of the Nano Reactor (patented technology) has allowed to achieve a more efficient process by reducing the use of reagents such as phosphoric acid by 90% and caustic soda by 30% as a minimum, and in terms of yield improvements by at least 02% , but expected above 0.4%. This presentation will show how this technology works, how easy it is to install in your existing plant or as part of a new installation; It will also show potential savings for non-uses of washing water and / or silica for the elimination of soaps, proving that it is a technology that every oil processor must have.

Revision on vacuum systems - conventional, alkaline closed loop and ICE condensation vacuum systems. Rodrigo Castro, *Koerting do Brasil, Brazil*

A revision and overview of different kinds of Steam Jet and Hybrid Vacuum Systems, from the conventional type with “dirty” cooling tower passing by the alkaline closed loop systems with warm or cold cooling water circuits to the Ice Condensation, their characteristics, similarities and differences. The importance of the condensation temperature will be shown and how it is related to the steam consumption and electrical energy requirement. An example comparation of CAPEX and OPEX will be presented.

Jet mixers for agitation or homogenization of edible oils or other liquids in tanks. Rodrigo Castro, *Koerting do Brasil, Brazil*

Industrial processes require stability to run the production without problems and unexpected adjustments during the process. As soon as the raw material is homogeneous, the successful outcome will be easier to be achieved during the whole process, leading to an intermediate or final product that always meets quality requirements. Jet mixers are one of the main points to guarantee that stability and can be applied for continuous and discontinuous mixing duties and they are customized for each specific tank. They can be used as complete replacement for mechanical agitators, being about 60% more energy efficient and, in many cases, they surpass their mixing results. The purpose of the tank mixing system is to generate a liquid circulation of the whole tank volume which leads to complete mixing and prevents sedimentation. A guided directional flow will be generated by the mixing system. Therefore, flow velocities occur, which are higher than the sinking velocities of the particles in the liquid, so that settlement is avoided. Once the settlement is avoided, the cleaning frequency is reduced dramatically, and savings related to loss of products, planned shutdowns and skilled labor are accounted. If the liquid is pumpable, jet mixers can be designed to meet every mixing requirement, guaranteeing homogeneous mixing of crude and degummed oils, fuels, waste water and even high-density substances.

Thursday, October 10, 2019

Crushing

Session Chairpersons: Héctor Autino, Bunge South America & ASAGA, Argentina; and Anibal Demarco, Desmet Ballestra, Argentina

Desarrollos recientes en la destilación de la planta de extracción por solvente. Marcelo Ferrero, *Plant Design SA, Argentina*

A partir del desarrollo de la simulación de procesos, de la aplicación de estudios de “Pinch Análisis” y los avances logrados en la industria de procesos de Oil & Gas, se presentarán las innovaciones y desarrollos aplicados en plantas de extracción por solvente para bajar el consumo de energía, minimizar pérdidas de solvente y eliminar los efluentes de plantas, yendo hacia una industria más sustentable y amigable con el medio ambiente. Se presentarán innovaciones y desarrollos concretos que se han implementado en la Destilación con éxito como un Super Condensador de Vacío en dos etapas, Stripper de Aceite Vegetal con platos perforados con un diseño auto-limpiante, innovaciones en el Stripper de Aceite Mineral para eliminar las pérdidas de aceite mineral, aprovechamiento total de vapor Flash de Condensados en la Destilación, y reducción de la temperatura del condensado de retorno a Caldera hasta 80 ºC para maximizar el ahorro energético, opciones de aprovechamiento de calor de los vapores de los Strippers, alternativas de Stripping del efluente acuoso con Columna de alta eficiencia, y alternativas para reducir el tamaño del Separador de Solvente para minimizar el stock de solvente en planta por seguridad. Además, se completará el análisis con las estrategias para minimizar las pérdidas de solvente y la utilización de un sistema de efluente cero para eliminar efluentes acuosos sin consumo de energía, todas medidas amigables con el medio ambiente en pos de una industria sustentable.

Es possible sustituir el hexano por etanol en la extracción por solvente? Orivaldo Balloni, *Alliance industria Mecánica Ltda, Brazil*

A utilização de etanol como solvente para extração de óleo foi muito estudada no passado, porém devido a falta de tecnologia da época, os custos industriais com hexano eram mais atraentes.Após a implantação do processo patenteado, constatou-se que a melhor alternativa para plantas futuras seria um processo que substituísse o Hexano pelo Etanol.Vários pesquisadores questionam a viabilidade dos chamados Biocombustíveis, por sacrificarem a produção de alimentos para produzir energia , onde o panorama de um futuro próximo é não termos condições de produzir alimentos para toda a população.Linhas de pesquisas vem sendo criadas para produzir combustíveis de resíduos da cana , bagaço de cana, liberando o caldo para produção de açúcar. O Gossipol é um composto tóxico (terpenoide) presente em glândulas isoladas do caroço de algodão.Dependendo das condições do processamento e das características do caroço de algodão, estas glândulas podem ser rompidas, liberando o gossipol em diferentes teores. O gossipol e seus derivados são tóxicos para animais monogástricos, mas mesmo para ruminantes é aconselhável limitar sua presença em rações, chegando-se no máximo a consumos de 3,0 – 3,5 kg/dia de caroço de algodão. Nos USA o FDA (Food and Drug Administration) permite a presença de até 450 ppm de gossipol livre em ingredientes alimentícios provenientes de caroço de algodão. A FAO (Food Administration Organization da ONU) e a WHO (World Heath Organization) admitem a presença de 600 ppm de gossipol e 1,2% de gossipol total. O teor de gossipol é o responsável pela limitação da quantidade de Farelo de Algodão utilizada nas rações animais.A obtenção de um Farelo livre de Gossipol possibilita um aumento da inclusão do Farelo de Algodão nas Dietas , gerando um aumento no tamanho do mercado deste produto.

Optimización energética en plantas de crushing de semillas oleagionosas. Mário Brugnollo, *Solex Thermal Science, Brazil*

Las mejoras y modificaciones en una planta de procesamiento de oleaginosas deben tener en cuenta, además del perfeccionamiento del proceso, los ahorros de energía y su impacto en los costos, a través de la recuperación de la energía calórica disipada por alguno de los equipos intervinientes en el proceso y la optimización de los procesos de transferencia de calor, apelando al diseño de equipos más eficientes.

Energy Optimization in Oilseed Crushing Plants. Mário Brugnollo*, *Solex Thermal Science, Brazil*

Improvements and modifications in an oilseed processing plant should take into account, in addition to improving the process, energy savings and its impact on costs, through the recovery of heat energy dissipated by any of the equipment involved in the process and the optimization of heat transfer processes, appealing to the design of more efficient equipment.

Hay límite para bajar la materia grasa? Anibal Demarco, *Desmet Ballestra, Argentina*

Siempre la Extracción de Aceite se considera como una optimización y un beneficio comercial en una plante de Crushing. De cualquier manera en algunos casos existe el planteamiento si es correcto sacar tanto aceite como se pueda debido a la extracción de algunos compuestos considerados como no deseados (Fosfolípidos y Ácidos graso libres). En este trabajo se muestra que el límite más conveniente es el menor residual posible. Siempre

hay una beneficio económico al extraer más aceite y por lo tanto optimizar el valor de los subproductos. No solo considerando el Crushing, sino también el beneficio se mantiene en la refinería.

Como reducir el consumo de hexano en la planta de extracción por solventes. Héctor Autino, *Bunge South America & ASAGA, Argentina*

El consumo de hexano en la Planta de Extracción por Solventes adquiere una importancia fundamental y que no se limita solamente a la reducción de costos variables dentro del proceso, sino que adquiere un rol preponderante en lo referido a aspectos que se relacionan con la Seguridad de la planta y de las personas y además con la protección y preservación del medio Ambiente. Dentro de la presentación estaremos analizando como reducir el contenido en los 4 fluidos que salen de la planta de Extracción y que pueden ser mesurables, entre los que podemos identificar de acuerdo a su orden de importancia a la Harina, el aceite, el aire y el agua que es derivada al curso hídrico, así como también las denominadas pérdidas no medibles o desconocidas y finalmente se presentarán experiencias prácticas con la intención de conocer como cada una de ellas impacta sobre el consumo total.

Quality Control and Analytical Techniques

Session Chairpersons: Silvana Martini, Utah State University, USA; and Juliana Ract, University of Sao Paulo, Brazil

Estudio de la cinética de gelificación por retrodispersión de luz. Maria L. Herrera[1], Nurys T. Hoyos Merlano[2], and Federico L. Jara[3], *[1]University of Buenos Aires, Argentina; [2]University of Buenos Aires-ITPN, Colombia; [3]University of Buenos Aires-ITPN, Argentina*

La legislación vigente en todo el mundo ha impulsado a la industria de alimentos a reformular sus productos. Se han empleado distintas estrategias para eliminar las grasas trans de los alimentos que han aportado en mayor o menor grado una solución a este problema. La preparación de geles a partir de emulsiones de proteínas es una estrategia que tiene la ventaja de permitir la elaboración de alimentos sólidos que contengan lípidos saludables (e incluso con beneficios específicos para la salud como evitar cánceres) provenientes de aceites vegetales o de pescado en cantidades deseables para mantener una buena salud y que no contengan ácidos grasos saturados o trans. El objetivo de este trabajo es explorar una nueva aplicación del análisis de estabilidad de emulsiones y coloides por Turbiscan, la evaluación de la cinética de gelificación. Se mostrará la potencialidad de esta técnica para la determinación de los tiempos de gelificación y se compararán los valores hallados con los obtenidos por técnicas tradicionalmente empleadas con este fin como la reología oscilatoria. En el ejemplo presentado se explorará el potencial de emulsiones estabilizadas con caseinato de sodio, una proteína muy empleada en la industria láctea, para preparar geles que podrían emplearse en alimentos que habitualmente requieren de la presencia de sólidos de grasa como es el caso de los postres. La gelificación probó ser una alternativa interesante para producir alimentos saludables.

Using the scientific method and key analytical techniques to mimic an edible fat product. Fernanda Peyronel, *Dept. of Food Science, University of Guelph, Canada*

This work will explore the challenges in manufacturing a new, commercial, edible, fat product that can perform as well as a pre-existing product -the control- , without prior knowledge of its makeup or processing procedure. The scientific method (hypothesis, measurements, analysis of data conclusions) will be followed to create an action plan. The action plan will require two hypotheses, first in regards to the ingredients of the recipe, second, in regards to the processing procedures. A step in the action plan will require performing measurements on the control using numerous analytical techniques to determine its physical characterization. Another step in the action plan is to use the data collected from the control-measurements to guide the choice of ingredients and the protocol to follow during manufacturing. Furthermore, the action plan will require cross-referencing applicable literature to ensure an effective choice of ingredients and processing conditions. By manufacturing the new product and measuring the same parameters as those measured for the control, the hypothesis will be validated. The success of the new product will be achieved when the measured values are similar to those of the control. The strength of the scientific method resides in doing iterative steps as needed in order to be successful. This work will discuss advantages and disadvantages of techniques such as X-ray diffraction, differential scanning calorimetry, rheometry, low resolution pulsed nuclear magnetic resonance, texture analyzer, and microscopy for the physical characterization of edible fats. This work will be complemented with examples.

Fast GC analysis of FAMEs in vegetable fats and oils. Daiane Magro[1] and Mariana Baptistao[2], *[1]Bunge, Brazil; [2]Agilent Technologies do Brasil, Brasil*

Objectives Vegetable oils and fats has essential fatty acids and are source of metabolic energy. It plays a very important role in nutrition and food chemistry. This work aims to study newest and fastest ways to separate fatty acid methyl ester (FAME) in vegetable oils and fatty samples.

Methods The sample treatment followed AOCS Official Method Ce 2-66. After, it was used a GC-FID system with a cyanopropyl phase column (20m x 0.18mm x 0.2µm), oven ramp from 80 to 230°C for 12 minutes, split (300:1) injection at 1µL. The carrier gas was Hydrogen at 28 psi. The FID was set to 250°C with Hydrogen at 40mL/min and make-up gas at 25mL/min. The software to acquire the data was OpenLab ChemStation C.01.07.

Results This fast method was able to separate all compounds from a 37 mix of FAMEs including DHA and EPA and real oil and fat vegetable samples such soybean, rapeseed, sunflower, cotton, palm and kernel. Analysis time was reduced from 60 minutes (based on an old method using another 120m cyanopropyl column) to 12 minutes. No big loss in resolution was detected when working in this fast method.

Conclusions The solution applied increased in five times the productivity in the results obtained and presented good resolution in the samples. It is possible to separate the isomers trans and cis from C18:1 and C18:2. This method can be used in other samples like fish oil and blends of total hydrogenated oils.

Extra virgin olive oils produced in Brazil: their composition and quality parameters. Aline G.A. Carvalho[1], Bruna R.A. Gaspar[1], Humberto R. Bizzo[2], Lucía Olmo-García[3], Alegria Carrasco-Pancorbo[4], Vanessa N. Castelo-Branco[5], and Torres Alexandre[6], *[1]Laboratory of Nutritional Biochemistry and Food Science Lipid Chemistry and Biochemistry Laboratory – Institute of*

Chemistry, Federal University, Brazil; [2]Embrapa Food Agroindustry, Brazil; [3]Environmental, Biochemical and Foodstuffs Analytical Control Research Group, University of Granada, Spain; [4]University of Granada, Spain; [5]Federal Fluminense University, Brazil; [6]UFRJ, Brazil

The present work aimed to determine the lipidic composition, the minor components profile and the main quality parameters of extra virgin olive oils (EVOO) produced in Brazil, in order to obtain relevant compositional data that could stimulate further research and use of national EVOO. Fifteen samples of EVOO were analyzed, 10 produced in Brazil and 5 produced in Spain (comparative samples). Quality indices were determined by applying official methods, while lipidic composition and minor components profile were studied by means of chromatographic methods. EVOO presented quality parameters within the ranges established by the International Olive Council (IOC), except for some specific results. Fatty acid profiles demonstrated the purity of the EVOOs. α-Tocopherol was the major tocopherol (ranging from 8.80 to 27.0 mg/100 g) in all samples, which also presented β- and γ-tocopherols. β-Sitosterol content was higher than the preconized by the IOC (1000 mg/kg). β-carotene (contents up to 1.0 mg/100 g) and pheophitin a (ranging from 0.15 to 1.99 mg/100 g) were the major pigments found in the samples. The volatile compounds profile presented typical flavor compounds such as aldehydes and alcohols. Most of the samples produced in Brazil presented quality indices within the IOC established levels. The samples showed varied minor components profiles with potential bioactivity and health benefits, such as high contents of α-tocopherol (vitamin E activity), and β-sitosterol (reduction of plasma cholesterol levels). No significant differences were found among Spanish EVOOs and those produced in Brazil. These findings are expected to stimulate national EVOO consumption.

Physical properties of hybrid palm oil produced in Brazil. Andréa M. Guedes[1], Rosemar Antoniassi[1], Melicia C. Galdeano[1], and Larissa C.G. Garcia[2], *[1]Embrapa Food Technology, Brazil; [2]Federal Rural University of Rio de Janeiro, Brazil*

Interspecific hybrid palm oil (Elaeis oleifera Kunth X Elaeis guineensis Jacq.) presents a distinctive fatty acid composition (high oleic acid content). Therefore, it can also exhibit unique physical properties not studied yet. However, data on these properties are still limited. The objective of this work was to study the refractive index (IR – Bausch & Lomb refractometer), relative density (D – Anton Paar Density meter) and thermal profile of hybrid palm oil produced in Brazil. Thermal properties were analysed by Diffraction Scanning Calorimetry (DSC). The IR (nD40°C) and D (40°/water 20°C) varied respectively from 1.4585 to 1.4622, and from 0.894 to 0.899. The crystallization curve (cooling rate of -5°C/min, from 80°C to -60°C, 10 min at 80°C), showed four exothermic peaks, with a lower number and a narrower range of exothermal events when compared to palm oil. The high melting group at 40°C, typically found in palm oil, was not observed in the hybrid palm oil, which can be caused by a low level of trisaturated triacylglycerols. Furthermore, unlike palm oil, that has two distinctive endothermic peaks (heating rate of 5 ºC/min/-60°C to 80°C, and 30 min at -60°C) representing low and high melting groups, the hybrid heating curve showed two broad peaks (-4°C and 7.5 to 9.5°C) and a sharp endothermic peak at around -2.5 to -4°C. However, the final melting temperature range was 37 to 44°C, corroborating the temperature suitable for relative density determination. These characteristics may lead to different products from fractionation compared to palm oil.

Non-food applications

Session Chairperson: Andres Guzman, Alchemy Ventures and Developments, Colombia

Natural-based surfactants in the modern detergent industry. Corrado Mazzanti, *Desmet Ballestra SpA, Italy*

The use of naturally-based and renewable materials for the production of a wide range of surfactants is described with particular emphasis on the technologies specifically developed to transform oils and fats into surfactants suitable for the widest variety of applications. The selection of fatty materials suitable for the transformation into surfactants is the basic step of the process route to produce safe, well performing and sustainable surfactants. The base operations necessary to upgrade the natural oils for the above scope are mentioned and the further steps dedicated to the production of Anionic, Non-Ionic and Amphoteric surfactants are described. The main field of application and the peculiarities of the mentioned types of surfactants are illustrated together with their market trend and production figures.

Obtención de biocombustible mediante hidrotratamiento catalítico de aceites oxidados. Elisa Volonterio[1], Iván Jachmanián[2], Ignacio Vieitez[2], and Martin Mittelbach[3], *[1]Facultad de Química, Universidad de la República, Uruguay; [2]UdelaR, Uruguay; [3]Institute of Chemistry, University of Graz, Austria*

En este trabajo se estudió el efecto del grado de oxidación del aceite de salvado de arroz, muy difundido en nuestro país para uso en frituras, sobre la eficiencia de su conversión a hidrocarburos mediante un proceso de hidrotratamiento catalítico. A los efectos de generar materia prima con un grado de oxidación creciente, muestras de aceite de salvado de arroz refinado fueron sometidas a termo-oxidación a 180 ºC durante diferentes períodos (entre 6 y 23h). Luego de caracterizar el grado de deterioro mediante la determinación de compuestos polares y polímeros, las muestras fueron procesadas en un reactor batch (Parr 4570 HP/HT, 250 mL), a 350 °C y 100 bar de H2 en presencia de un 1 % de catalizador Pd/Al2O3. Las reacciones se extendieron por un período de 4h durante el cual regularmente se realizaron tomas de muestra de la mezcla de reacción. Del tratamiento de aceites oxidados con diferente porcentaje de polares (de 19 a 37%) y contenido de polímeros (de 4 a 14%) fue posible alcanzar un producto sin residuo de triglicéridos y con un contenido total de hidrocarburos de entre un 96,0 y 99,1%. Dicho rendimiento fue muy similar al 99,5% alcanzado en el hidrotratamiento en las mismas condiciones del aceite de arroz sin oxidar. En todos los casos el hidrocarburo mayoritario presente en el producto de reacción fue el heptadecano (C17, entre 48,3 y 55,0%), lo que sugiere que los mecanismos de conversión predominantes fueron la decarbonilación y/o descarboxilación, que se caracterizan por reducir en un carbono la cadena hidrocarbonada. También se observó que la presencia de hidrocarburos cortos, provenientes de la ocurrencia de cracking, aumentó con el aumento del grado de oxidación del aceite de partida. El análisis de los diferentes productos por destilación simulada (SimDis) arrojó curvas de destilación idénticas para todos los productos y con un alto grado de coincidencia con la obtenida para el gasoil de origen fósil convencional. Los resultados obtenidos demostraron que el hidrotratamiento catalizado por Pd permite obtener una buena conversión a hidrocarburos aún a partir de materiales grasos con alto grado de deterioro, lo que resulta muy atractivo para producción de

biocombustibles líquidos de segunda y tercera generación.

Adsorptive removal of contaminants from fats and oils for production of biofuels. Brian S. Cooke, *Clariant, USA*

Both Biodiesel and Renewable Diesel are derived from fats and oils. These fats and oils can often present challenges in the process due to contaminants that interfere with the efficiency of the reaction often resulting in a decrease of catalyst activity. This study looks at the removal of these contaminants to help with the biodiesel reaction efficiencies as well as helping to protect the catalyst used during the hydrotreating process for renewable diesel. The use of activated clay has been shown to remove these contaminants through the process of adsorption.

The life of the catalyst for renewable diesel can be significantly improved by removing contaminants such as metals and phosphorus. This can result in significant cost savings during the production of renewable diesel.

The activated clay can also be used to remove contaminants from the crude biodiesel, such as glycerol, soap and metals. It is imperative that these contaminants are removed to ensure that the biodiesel will meet the desired specifications.

Online process control on fats and oils refining: technologies and case studies. Danilo M. Lima[1], Nivaldo Carvalho[2], Mariana Dias[2], Hubertt Elias[1], Fidelis Zuffi[3], and Roberto Pedroso Filho[4], *[1]brprocess, Brazil; [2]Buchi Brasil Ltda, Brazil; [3]APsiC Systems, Brazil; [4]Digitrol Ind e Com Ltda, Brazil*

Online analytical measurement (installed directly on a process stream) has been widely spread in crushing plants (for meal drying and other applications), as well as in other industries, as ethanol, brewery and pet food. However, in the edible oil refining world, there are few references. It has been possible to evaluate the efficiency of this type of equipment on the last twelve months on three different refineries, in three different sections and streams: a) a NIR-Online equipment after deodorizer in refined palm oil; b) a NIR-Online equipment before neutralization section in degummed soybean oil and c) an online photometer for chlorophyll measurement after bleaching section in soybean oil. After calibration stage, surprisingly good standard deviation compared to laboratory (primary analysis) was achieved for all three cases: a) FFA as 0,0035%, Lovibond Red as 0,13; b) FFA as 0,05% in a range of 0,6% to 1,5%, soaps as 10 ppm, water as 0,005% and c) below 10 ppb in a range of 0 to 300 ppb. Other parameters have been calibrated as they demand a larger number of samples. In addition, it will be shown the concept of an advanced process automation software/hardware which reads the data from online analyzers as well as other process parameters from central CLP, using a combined fuzzy logical system which evaluates and controls simultaneously all variables that are interferences for the desired output. This automation concept, together to online analyzers, have been used on case studies as a powerful tool for savings of bleaching earth, chemicals and losses, as well as process control intelligence.

Development of a glycerine based, water soluble polymer for use in the wood products industry. Andrew N. Becker, Joseph H. Podolsky, Chris Williams*, and Eric Cochran, *Iowa State University, USA*

Iowa State University (ISU) has developed a glycerine-based, water soluble polymer which is a significant advancement because of the ability to use it in a wide range of applications and is being rapidly scaled for commercialization in the wood products industry. The wood products industry has undergone significant changes in the use of adhesives in the past few years with the elimination of formaldehyde based materials (e.g. urea-formaldehyde) through the United States Environmental Protection Agency regulations and the shift to other materials such as polymeric diphenyl methane diisocyanate (PMDI). The use of PMDI also has its challenges as it is more expensive than the previously used urea-formaldehyde materials and its ability to maintain board integrity during the manufacturing process. ISU has demonstrated at the benchtop and pilot plant scale that controlled radical polymerization can be used to form high molecular weight branched thermoplastics from glycerine acrylate monomers with more than one acrylic functional group. Cochran and Williams have developed the understanding and methods to suppress the gelation of these polymers for use as branched thermoplastics. The development of the poly acrylated glycerine polymer is extremely tacky and has allowed for the elimination of the use of a tackifier and allowed for the decrease in the use of the more expensive PMDI by up to 90%. The PAG is solvated with water at a 50-50 ratio and used through spray-applied methods with the PMDI in making particle board, oriented strand board, and medium and high density fiberboard. The commercial scale work is ongoing at the prestigious Fraunhofer Institute for Wood Research in Braunschweig, Germany. The PAG is continuing to be scaled in the wood products industry through forthcoming full-scale production at a mill facility in the upcoming months. This will involve the production of PAG at the 1 ton/day ISU biopolymer pilot plant. The pilot plant has already demonstrated its ability to produce a different biopolymer product using the same radical polymer production process used to produce PAG. If the commercial/mill production is successful, there will be an excellent likelihood of commercialization of this glycerine-based polymer.

Processing and Refining

Session Chairpersons: Roberto Berbesi, Oil-Dri Corporation of America, USA; and Leon Pablo Espinosa, Desmet Ballestra NA, Inc., USA

Impact of oil moisture and acidulation on improving bleaching clay efficiency. David Brooks, *Oil-Dri Corporation of America, USA*

Employing water and or acids in solution with vegetable oils to improve refining processes is a known art to the industry.

Impact to bleaching performance, as applied to the “bleaching” process is dependent on the bleaching clay mineralogy and oil quality.

For illustration, the beneficial impact of added moisture, citric and phosphoric acids on the bleaching performance of attapulgite based bleaching clays will be presented across soybean and palm oil processing applications; specifically with respect to reduction of chlorophyll, trace elements, and glycidyl esters.

How to keep full capacity of your filters in edible oil. Tony Dinsbach, *Filtration Group BV, The Netherlands*

Many companies face over the years problems with their filters. Filtration runs getting shorter, cleaning of the filters don't work anymore. Drying of cake not optimal and cost of maintenance is going up. We will try to show how to prevent these problems and how to keep the full capacity of your filters.

Low pressure dual temperature deodorization; an ideal solution to mitigate the formation of both trans fats and glycidyl esters. Marc J. Kellens and Alan Paine, *Desmet Ballestra Group, Belgium*

Increasing organoleptic and nutritional quality demands and more stringent limits for unwanted minor-components in edible oils are challenging todays refining industry to seek new solutions and continuously adapt its processing methods. On top of this, environmental and economic concerns drive refineries to become more sustainable and cost-efficient. With a vegetable oils and fats market being more and more dominated by palm oil and soybean oil, it is quite evident that most new solutions are tailored to these two major oils. Deodorizing is the last and for most oils the most critical stage in the refining process. With the trans fatty acids (TFA) issue popping up in the 90's, there was a distinct change in deodorizing conditions in the 2000's especially for soft oils like soybean and rapeseed oil. The current glycidyl ester (GE) problem, is mainly linked to palm oil, and deodorizing conditions are again under study. The formation of both contaminants, although distinctly different, are directly linked to the deodorizing conditions. Temperature and time are the key factors affecting TFA formation whereas for GE, the pressure also plays an important role. There is a clear trend towards milder deodorizing conditions under low pressure for all oils, be they highly unsaturated or more saturated oils. Dual temperature deodorization, a proven solution to mitigate formation of TFA in case of soybean oil, is now also seen as one of the solutions to mitigate GE. In contrast to TFA, GE can be removed by stripping, hence the operating pressure in the deodorizer plays an additional but important role. The presentation aims to provide various solutions to mitigate both TFA & GE, while ensuring excellent organoleptic quality and stability.

Glycerin Triple Effect Evaporator. Marcos Felipe Gerber Wietzikoski, *Crown Iron Tecnologias, Brazil*

This paper will discuss how a triple-effect evaporator works on the water/glycerin evaporation system. The paper will make an analysis more focused on glycerin produced from biodiesel plants, however same concepts can be applied to fat splitting and saponification plants. The crude glycerin typically still contains a large amount of water and may present risk of damage by fermentation if stored for long periods and high transportation costs. So, this stream needs to pass through a Triple Effect Evaporator System to remove the appropriate amount of water for obtaining a high-quality crude glycerin. However, this operation may be cost intensive and special attention should be given. The objective of this paper is to describes the operation of a triple-effect evaporator to concentrate a diluted water/glycerin liquid solution using significantly less energy than a single-effect evaporator. Together with the ACRE system and Three Phase Rectification Column, the system can achieve low utility consumption.

Este artigo discutirá como um evaporador de efeito triplo funciona no sistema de evaporação de água / glicerina. O artigo fará uma análise mais focada na glicerina produzida a

partir de plantas de biodiesel, no entanto, os mesmos conceitos podem ser aplicados a plantas de frcionamento e de saponificação. A glicerina bruta ainda contém tipicamente uma grande quantidade de água e pode apresentar risco de danos por fermentação se armazenada por longos períodos e altos custos de transporte. Portanto, essa corrente precisa passar por um Sistema Evaporador de Triplo Efeito para remover a quantidade apropriada de água para obter uma glicerina bruta de alta qualidade. No entanto, esta operação pode ter um custo intensivo e deve ser dada atenção especial. O objetivo deste trabalho é descrever a operação de um evaporador de efeito triplo para concentrar uma solução líquida de água / glicerina diluída usando significativamente menos energia do que um evaporador de efeito único. Juntamente com o sistema ACRE e a coluna Trifásica de Retificação, o sistema pode atingir um baixo consumo de energia.

The Role of Synthetic Amorphous Silica in Enzymatic Interesterification. Carlos A.C. Leibel[1] and Carlos A. Bravo[2], *[1]W.R. Grace Brasil Ltda, Brazil; [2]W.R. Grace Argentina, Argentina*

A method and system for the enzymatic treatment of a lipid containing feedstock comprises contacting the feedstock with a processing aid, then causing the feedstock to pass at a substantially constant flow rate through a treatment system comprising a plurality of enzyme-containing fixed bed reactors connected to one another in a series. The fixed bed reactors can be individually serviceable, the flow rate of the feedstock remaining substantially constant through the system when one of the fixed bed reactors is taken off-line for servicing. In the most preferred embodiment, the processing aid is a substantially moisture-free silica. The processing aid can be placed in one or more of the fixed bed reactors, disposed above the enzyme in the reactor, or it can be in a pre-treatment system which can comprise one or more reactors.

Quality Control and Analytical Techniques

Session Chairpersons: Silvana Martini, Utah State University, USA; and Juliana Ract, University of Sao Paulo, Brazil

Formation of 2-MCPDE under different conditions of time and temperature. Renan G. Tivanello[1], Maisa F. Capristo[2], Eduardo Vicente[3], Roseli A. Ferrari[3], Klicia A. Sampaio[2], and Adriana P. Arisseto[2], *[1]University of Campinas, Brazil; [2]Faculty of Food Engineering, University of Campinas, Brazil; [3]Institute of Food Technology, Brazil*

Esterified forms of monochloropropanediols, including esters of 3-monochloropropane-1,2-diol (3-MCPDE) and 2-monochloropropane-1,2-diol (2-MCPDE), are a group of process contaminants, especially found in refined vegetable oils, which represents a human health concern. Palm oil has shown the highest concentrations of these substances compared to other oils. Although many studies have been conducted in order to elucidate the formation of 3-MCPDE in palm oil during the deodorization, very little information exists regarding 2-MCPDE. So, the focus of this research was to investigate the formation of 2-MCPDE under different processing conditions (time and temperature) and compare the results with the amounts of 3-MCPDE. For that, bleached palm oil was deodorized in a laboratory-scale batch deodorizer. Four temperatures (210, 230, 250 and 270 °C) and four different stripping times (30, 60, 90 and 120 minutes) were investigated, while the steam percentage was fixed at 1%. The contaminants were analyzed using the official AOCS method Cd 29-a 13. The levels of 2-MCPDE varied from

0.68 to 1.45 mg/kg, while 3-MCPDE concentrations ranged from 1.91 to 2.70 mg/kg. The results confirmed that 2-MCPDE are formed at lower concentrations than 3-MCPDE in all tested conditions. In addition, the formation of 2-MCPDE was directly proportional to the temperature, but this was not observed for 3-MCPDE. It can be suggested that the contaminants may have different kinetics or formation routes. This work was supported by the São Paulo Research Foundation (FAPESP) under Grant number 2016/23958-3

Aqueous wash of crude organic palm oil: oil quality and formation of esters of 2-MCPD and 3-MCPD in the refined oil.

Jessika K. Santiago, Renan G. Tivanello*, Maisa F. Capristo, Roseli A. Ferrari, Eduardo Vicente, Antonio A. Meirelles, Adriana P. Arisseto, and Klicia A. Sampaio, UNICAMP, Brazil

Organic palm oil consists of an agricultural production, which does not use chemical inputs, standing out for the preservation of the whole environment. Although not using agrochemicals, the soil may contain minerals, among them chlorides, which are precursors of food contaminants known as chloropropanols esters, including 3-MCPD (3-monochloropropane-1,2-diol) esters and 2-MCPD (2-monochloropropane-1,3-diol) esters. In this concept, the addition of an aqueous wash step seeks to remove possible hydrophilic chlorinated precursors still present in the oil (endogenous form) and, consequently, to reduce the formation of the contaminants. Thus, the aim of this study was to evaluate the best proportion of water (20, 30 or 40% w/w) to be used as a pretreatment to chlorides removal prior to the traditional physical refining. The oil washed with water was submitted to bleaching and deodorization processes. According to the results, 30% w/w of water was the condition that promoted the higher chlorides removal (3.81 mg/kg) when compared to 20 and 40% (1.46 and 3.50 mg/kg). The free fatty acids (FFA) of the oil washed with 30% w/w of water were almost completely removed after deodorization, while the color remained between 2.1-2.4R and 22-20Y for treatments with or without water washing, respectively. The 3-MCPD and 2-MCPD values after water washing were reduced in 28% and 35%, respectively. Therefore, this work confirms that the contaminants are formed in organic oils and that the water washing can promote a considerable reduction in the levels of these substances.

This work was supported by the São Paulo Research Foundation (FAPESP) under Grant number 2016/23958-3.

Freeze-thaw stability of margarines prepared with coconut and palm oils // Estabilidad frente a la congelación-descongelación de margarinas preparadas con aceites de coco y palma.

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El objetivo fue analizar la estabilidad frente a la congelación-descongelación de emulsiones símil margarina preparadas con grasas vegetales sin tratamientos de hidrogenación

o interesterificación. Las emulsiones fueron preparadas con 20% p/p de fase acuosa dispersa y una fase lipídica compuesta por aceite de coco (AC) y/o aceite de palma (AP) más polirricinoleato de poliglicerol (PGPR) como emulsionante. Además, se preparó un sistema control con aceite de girasol. La estabilidad de las emulsiones fue estudiada mediante la aplicación de sucesivos ciclos de temperatura (enfriamiento-calentamiento-enfriamiento) por calorimetría diferencial de barrido, analizando los cambios observados en el pico exotérmico correspondiente a la congelación de la fase acuosa dispersa. La emulsión formulada con AC (sin AP) y 1% p/p de PGPR en la fase lipídica sufrió cambios sustanciales en su microestructura tras la aplicación de los ciclos térmicos. Por otro lado, el sistema preparado con AC y 2% p/p de PGPR resultó ser totalmente estable frente al tratamiento. La sustitución total o parcial (50%) de AC por AP en emulsiones con 1% p/p de PGPR también mejoró la estabilidad del sistema, lo cual estaría vinculado a un menor tamaño inicial de gotas de agua. En cuanto a la muestra control, se observó una desestabilización progresiva por coalescencia, atribuida a la ausencia de cristalización en la fase lipídica continua. En conclusión, es posible obtener emulsiones símil margarina con AC y AP y buena estabilidad frente a la congelación-descongelación si se controla la concentración de emulsionante y/o la relación porcentual de ambas grasas.

The objective was to analyze the freeze-thaw stability of margarine-like emulsions prepared with vegetable fats without hydrogenation or interesterification treatments. Emulsions were prepared with 20% w/w dispersed aqueous phase and a lipid phase composed by coconut oil (CO) and/or palm oil (PO) plus polyglycerol polyricinoleate (PGPR) as emulsifier. Moreover, a control system was prepared with sunflower oil. The stability of emulsions was studied by the application of successive temperature cycles (cooling-heating-cooling) with differential scanning calorimetry, analyzing the changes observed in the exothermic peak corresponding to freezing of dispersed aqueous phase. The emulsion formulated with CO (without PO) and 1% w/w PGPR in lipid phase suffered substantial changes in the microstructure after the application of the temperature cycles. On the other side, the system prepared with CO and 2% w/w PGPR was totally stable against the treatment. The total or partial (50%) substitution of CO by PO in emulsions with 1% w/w PGPR also improved the stability of the system, which would be linked to a smaller initial size of water droplets. With regard to the control sample, a progressive destabilization by coalescence was observed, attributed to the absence of crystallization in the continuous lipid phase. In conclusion, it is possible to obtain margarine-like emulsions with CO and PO and good freeze-thaw stability if emulsifier concentration and/or percentage relation of both fats are controlled.

Evaluación del potencial antioxidante de extractos obtenidos a partir de frutos nativos de Uruguay mediante maceración con distintos solventes y extracción supercrítica. Ignacio Vieitez, Amelia Rosso, Emiliana Fariña, and Margot Paulino, *UdelaR, Uruguay*

Sustituir antioxidantes sintéticos potencialmente carcinogénicos por antioxidantes naturales resulta de interés y permitiría generar productos estables frente a los procesos de oxidación sin potenciales efectos perjudiciales para la salud. En este sentido, muchas de las hierbas y frutos que ya tradicionalmente se utilizan en la industria para añadir sabor o con usos en la medicina folklórica pueden resultar una matriz rica en antioxidantes naturales. Los métodos tradicionales de extracción de productos naturales suelen involucrar la utilización de solventes orgánicos inflamables o tóxicos y altas temperaturas que aceleran la degradación de

los productos de interés y la formación de impurezas. En cambio la sustitución de estos solventes por fluidos supercríticos, particularmente con dióxido de Carbono (SCCO2), que ha sido propuesto como una alternativa muy atractiva que presenta numerosas ventajas. En este trabajo se determinó la eficiencia de la extracción SCCO2 del fruto Guayabo del País (Acca sellowiana (Berg.) Burret), y Arazá (Psidium cattleianum Sab.) rojo y amarillo (frutos nativos de Uruguay), a los efectos de obtener extractos con potencial antioxidante en comparación con una extracción tradicional (maceración con EtOH/H2O 75:25). Para realizar las extracciones supercríticas se utilizó un extractor de laboratorio con una capacidad de 50 mL, el cual se operó a presiones de 200 o 400 bar, temperatura de 40°C, flujo de 0,5 L/min CO2 promedio. Para evaluar el poder antioxidante de los diferentes extractos se realizaron los métodos de ABTS y DPPH. El método ABTS consiste en determinar la actividad antioxidante de un compuesto o extracto frente a una sustancia cromógena de naturaleza radical (ABTS•+) y es aplicable en sistemas antioxidantes hidrofílicos y lipófilicos; mientras que en el DPPH usa un radical disuelto en medios orgánicos y, por lo tanto, es aplicable en sistemas antioxidantes hidrofóbicos. En los extractos supercríticos (SCCO2) los obtenidos a 200 y 400 bar, del Arazá amarillo presentaron la mayor capacidad antioxidante y los del Guayabo del País la menor. En cambio, el extracto de Guayabo del País obtenido mediante la extracción con EtOH/H2O, presentó la mayor capacidad antioxidante (0,93 mg de equivalente ác. Ascórbico/L), en concordancia con el resultado obtenido mediante el ensayo de DPPH, en el cual presentó el de mayor valor de poder antirradicalario (ARP).

Oxidative stability and diterpenes composition of cold-pressed green coffee oil oxidized at elevated temperatures. Jéssika R. Morgado[1], Rodrigo M.V.da Silva[2], Claudia M. de Rezende[3], Thais M. Uekane[4], and Vanessa N. Castelo-Branco[5], *[1]Laboratório de Biotecnologia de Alimentos, Faculdade de Farmácia, Universidade Federal Fluminense, Niterói, Brasil, Brasil; [2]Laboratório de Análise de Aromas, Instituto de Química, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brasil; [3]Laboratório de Análise de Aromas, Instituto de Química, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brasil , Brazil; [4]Laboratório de Bromatologia, Faculdade de Farmácia, Universidade Federal Fluminense, Brazil; [5]Federal Fluminense University, Brazil*

The aims of present study were to investigate the oxidative stability and the degradation of diterpenes during oxidation of cold-pressed green coffee oil at elevated temperatures. Aliquots of green coffee oil (in duplicate) were oxidized at 100, 130, 150 and 180 °C for 12 hours in the dark and were removed in 3, 6 and 12 hours. No-oxidized oil was used as control. Oxidative stability was monitored by peroxide (primary oxidation products) and p-anisidine (secondary oxidation produtcs) values. Cafestol and kahweol were determined by reversed-phase HPLC-DAD with isocratic elution (acetonitrile:water, 55:45 v/v) and detection at 230 nm. Commercial standards were used for identification and quantification of peaks (mg/100 g) by external calibration. Peroxide value increased linearly with oxidation time ($r>0.91$; $p<0.05$) for all temperatures, except at 180 °C, which remains constant between 3-12 h, probably due higher instability of hydroperoxyde in this temperature. Otherwise, p-anisidine value increased linearly with oxidation time only at 150 °C ($r> 0.99$; $p <0.001$), reaching an increase of 167% at oxidation end-point. At 130 and 180 °C, p-anisidine value increased 21% and 91%, respectively, suggesting low formation at 130 °C and higher degradation at 180 °C. Kahweol loss was directly proportional to increase in temperature, reaching 4.5%; 22.5% and 50.3% at the end-point of 130, 150 and 180 °C, respectively. On opposite, degradation of cafestol was significant only at

180 °C (33%). Therefore, oxidative stability of green coffee oil reduced with temperature increasing. Besides kahweol was more stable than cafestol during oxidation at elevate temperatures.

Lipid recovery from oleaginous yeast biomass for biofuel production- A critical review. Mahesh B. Khot[1], Gouri A. Katre[2], Manuel Alarcon[3], Carolina Parra[1], Pankajkumar Waghmare[4], Ameeta Ravikumar[5], Debashish Ghosh[6], and David Contreras[7], *[1]Centro de Biotecnologia, Universidad de Concepcion, Chile; [2]Agharkar Research Institute, India; [3]Universidad del Biobio, Chile; [5]Shandong University, China; [5]Savitribai Phule Pune University, India; [6]CSIR-Indian Institute of Petroleum, India; [7]Universidad de Concepcion, Chile*

Lipid recovery from oleaginous yeast biomass for biofuel production- A critical review Lipids of oleaginous yeasts are emerging as alternative renewable feedstock for biofuels and fatty acid based oleochemicals. The quantitative recovery of all the different lipid classes from the yeast cells is a critical step to their subsequent analysis and development of a bioprocess. Multiple extraction procedures have been developed for the yeast lipids, but not a single standard method of choice is available. The rigid yeast cell wall makes it the most resistant cell type and differences do exist between the cell wall composition of oleaginous and non-oleaginous species. This study represents a review on yeast lipid recovery in the context of biofuel production process. Cell lysis by existing different lab-scale physical, chemical and mechanical conditioning methods were critically reviewed and compared. Furthermore, the cell wall of oleaginous yeasts is briefly discussed to emphasize the need for understanding the yeast cell wall chemistry to design the lipid extraction method.

Friday, October 11, 2019

Functionality in food

Session Chairpersons: Andres Rumayor, Palsgaard Industri de Mexico, Mexico; and Bruno A. Irigaray, UdelaR, Uruguay

Efecto del porcentaje de cera de abeja usado como estructurante en oleogeles de diferentes aceites sobre sus estabilidades oxidativas. Bruno A. Irigaray[1], Natalia Martinez[2], Jimena Lázaro[3], Nadia Segura[3], and Iván Jachmanián[2], *[1]Facultad de Química, Montevideo; [2]UdelaR, Uruguay; [3]Facultad de Química, Uruguay*

El objetivo de este trabajo fue estudiar la estabilidad oxidativa de oleogeles preparados con tres aceites diferentes: girasol común (SFO), girasol de alto oleico (HOSFO) y chía virgen (CHO), estructurados mediante adición de cera de abeja (BW) en diferente concentración (2 y 6%). La estabilidad oxidativa se determinó mediante enranciamiento acelerado monitoreado por calorimetría diferencial de barrido (DSC Shimadzu 60A-Plus) en modalidad isotérmica, bajo atmósfera de oxígeno. A partir de los períodos de inducción obtenidos se determinó las constantes de velocidad del proceso de oxidación (k, en min-1) considerando una cinética de orden 1. Se determinó el contenido de tocoferoles en los aceites mediante análisis por HPLC equipado con detector de fluorescencia. El CHO fue el aceite que presentó el mayor contenido de tocoferoles (1694ppm), mientras que el SFO y el HOSFO presentaron niveles similares (758 y

700ppm, respectivamente). Pese a estas diferencias en el contenido de tocoferoles, el grado de insaturación del aceite fue determinante sobre la estabilidad oxidativa de los aceites sin estructurar, presentando mayor constante de velocidad cuanto más insaturado: kHOSFO,140°C = 0.0091min-1, kSFO,140°C = 0.036min-1, kCHO,140°C = 0.12min-1. El enranciamiento acelerado del SFO estructurado tanto con 2 (concentración crítica) como con un 6% de BW presentó los mismos valores de k que el aceite sin estructurar. En cambio, el enranciamiento de las muestras de CHO y el HOSFO conteniendo 2% de BW arrojó valores de k superiores al del aceite sin estructurar e inferiores al aumentar el contenido de BW a un 6%. Los resultados obtenidos indican que, si bien, la adición de este estructurante a niveles de 2 y 6% a los tres aceites ejerció algún efecto sobre los valores de k de ellos, dicho efecto no fue muy drástico, observándose en todos los casos el grado de instauración de los aceites fue determinante sobre sus estabilidades oxidativas. En conclusión, la adición de BW a la concentración crítica (2%) afectó de manera diferente la estabilidad oxidativa de los aceites estudiados, la adición a un 6% no presentó ningún afectó negativo sobre dicho parámetro.

Effect of α-tocopherol and β-sitosterol addition to physical structure of candelilla wax oleogels. Vanessa O. Di Sarli[1], Gabriela B. Brito[2], Denes K. Rosário[2], Karina F. Delgado[2], Carlos A. Conte[2], Erika CAN Chrisman[1], Torres Alexandre[3], and Vanessa N. Castelo-Branco[2], *[1]Federal University of Rio de Janeiro, Brazil; [2]Federal Fluminense University, Brazil; [3]UFRJ, Brazil*

Effect of α-tocopherol and β-sitosterol addition to physical structure of candelilla wax oleogels The aim of the study was to evaluate the influence of α-tocopherol and/or β-sitosterol addition on physical structure of candelilla wax oleogels. Oleogels were composed by oil phase (canola oil), structuring agent (candelilla wax) and α-tocopherol and/or β-sitosterol. Concentrations of wax (0.5 or 4% w/v), α-tocopherol (0 or 5% w/v) and β-sitosterol (0 or 10% w/v) were combined according the full factorial design 2^4 with four central points. Qualitative variable “addition order of bioactive compound” was also considered into experimental design. Physical structure response variables were: hardness and adhesiveness (texture), viscosity recovery (%) (20 to 80 °C; 80 to 20 °C), cross-over point of elastic (G’) and viscous (G’’) modulis a function of temperature (20-80 °C) and stress sweep (0.1-1000 Pa) (rheology) were determined. Higher concentrations of candelilla wax increased hardness, adhesiveness,cross-over point of G* and recovery viscosity of oleogels. However, when lower concentration of β-sitosterol was added in combination with wax resulted in a more adhesive oleogels. The temperature of cross-over point of G’ and G” increased with lower concentration of α-tocopherol, especially when added to oil phase before wax. Also, α-tocopherol influenced to increase the temperature and stress of cross-over point of G’ and G”, resulting in more stable oleogels against temperature and external forces variation. Oleogels prepared with lower concentration of α-tocopherol and β-sitosterol added into oil before the wax showed higher viscosity recovery. Therefore, incorporation of α-tocopherol and β-sitosterol to candelilla wax oleogels altered their physical structure which enables their application in food products.

Tripalmitin-driven crystallization of palm oil and the effects of shear, dispersion concentration, and interfacial chemistry. Ryan M. West[1], and Dérick Rousseau*[2], *[1]Procter & Gamble, USA; [2]Ryerson University, Canada*

While palm oil (PO) has proven to be a reliable ingredient for the formulation of biscuits,

cream fillings, and compound chocolates, our understanding of its crystallization behaviour and physico-chemistry pales in comparison to many fats and oils. Phase diagrams of binary mixtures are often used to elucidate its polymorphism and crystal composition, however conditions important to the food industry (e.g., shear, relevant processing temperatures, presence of secondary ingredients) are regularly overlooked. In this study, we explored the effects of shear (e.g., 0-500 RPM), dispersion concentration (e.g., 0-5 wt.%), and dispersion interfacial chemistry (e.g., silica or octadecyl-silica) on the thermal properties of commercial PO when cooled from 60 to 20 °C at 1 °C·min-1. Using a top-down approach with chemical standards, x-ray diffraction revealed PO to be a semisolid at 20 °C composed mainly of pure tripalmitin (PPP) crystals and molecular compounds (MCs) of PPP with either 1,2-dipalmitoyl-3-oleoyl (PPO) or 1,3-dipalmitoyl-2-oleoylglycerol (POP), all in a double chain-length β' conformation. Shear increased the formation of lower-melting α crystals as well as MCPPO:PPP while depleting the system of MCPOP:PPP and pure PPP crystals. This loss was further exacerbated by the addition of dispersion to the point where PPP was completely incorporated into MCs and pure β' crystals were eliminated. While dispersions tend to favour kinetic products through heterogeneous nucleation, we surprisingly did not observe a significant difference in either polymorphism or crystal composition based on dispersed particle interfacial chemistry. Neither POP nor PPO crystallized in the absence of PPP, suggesting that PO crystallization is heavily driven by its PPP content (e.g., ~ 5 wt.%) which may be a venue for industry to exploit.

Crystallization of interesterified soybean oil on a scraped surface heat exchanger using high intensity ultrasound. Thais Silva and Silvana Martini, *Utah State University, USA*

Crystallization of interesterified soybean oil on a scraped surface heat exchanger using high intensity ultrasound High intensity ultrasound (HIU) has been used to improve physical properties of fats. Few studies report using HIU on continuous systems but this technology has never been used in a scraped surface heat exchanger (SSHE). The aim of this research is to couple HIU with a SSHE and evaluate the physical properties of a low saturated fat. The SSHE operated at a flow rate of 19.2 mL/min, crystallization temperature of 32°C, pressure of 2 bars, and barrels/pin worker speed of 344/208 rpm, respectively. HIU was applied at amplitudes between 20-80% using continuous or 5 seconds pulses. The microstructure, melting behavior, rheology, and oil binding capacity (OBC) of the samples were evaluated. Sonication with an amplitude of 20% resulted in OBC values of 68% and 80% and G' values of 45,661Pa and 75,660Pa, for the continuous and the 5 s mode respectively. A maximum effect was observed when the sample was sonicated using 50% amplitude with OBC values of 70% and 81.3% and G' values of 59,530Pa and 100,238Pa for the continuous and the 5 s modes respectively. As the sonication amplitude increased above 50% G' and OBC decreased especially for the samples sonicated continuously at 70 and 80% amplitude. These samples were statistically similar to the control (OBC=61% and G'=25,255Pa). In general, no differences were found in the melting behavior parameters. Samples with higher G' and OBC did not show any cluster-like crystals as the ones observed in the control. These results show that HIU can be used at low power levels to brake crystal clusters formed during the crystallization into small crystals and allow the sample to crystallize in a more organized and stronger crystalline network.

What can you learn about chocolate using USACS. Fernanda Peyronel, *Dept. of Food Science, University of Guelph, Canada*

Abstract not available.

Non-food applications

Session Chairperson: Andres Guzman, Alchemy Ventures and Developments, Colombia

Aceite dielectrico vegetal en base a oleinas de palma. Pedro M. Bernal[1] and Cesar Coronado[2], *[1]Del Llano S.A., Colombia; [2]Diveg SAS, Comoros*

Los aceites dielectricos minerales (ADM) son altamente contaminantes, no son biodegradables, su punto de fuego es muy bajo y son menos capaces de atrapar humedad sin perder sus caracteristicas dielectricas Hay aceites dielectricos vegetales (ADV) hechos con base en aceites de soya y canola El objetivo era diseñar un ADV con base en oleinas de palma que tenga la misma resistencia a la oxidación que el aceite de palma, que logre mantenerse fluido a bajas temperaturas y que tenga TODAS las características dielectricas necesarias, además de ser biodegradable Se trabajó en la modificación de las temperaturas y tiempos de la refinación y fraccionamiento del aceite de palma para lograr oleinas con las características deseadas El resultado es un ADV biodegradable, en base a Oleinas de palma que cumple, y el algunos analisis excede, las condiciones requeridas y deseadas para un aceite dielectrico. el proceso y el producto estan en proceso de patente.

Fouling development during refining campaigns and the use of special surfactants for an enhanced CIP procedure. Lucas Klettenhofer, Florivaldo Galina, Hubertt Elias, Luis Paulo Ribeiro, and Danilo M. Lima, *brprocess, Brazil*

Fouling development during refining campaigns and the use of special surfactants for an enhanced CIP procedure Edible oil refineries are designed to operate year around continuously. Throughout campaign, inspection evidences fouling development and reflections on plant performance. Work reviews causes for fouling, connected to function of equipment. Secondly, compares industry-standard to specific-purpose cleaning procedures. Equipment inspection and maintenance was executed with photographic record. While in operation, working parameters were collected and trendlines deployed to evaluate tendencies connected to fouling. Cleaning procedures were performed with varying parameters. Normal organic fouling exerted effect over capacity, separation, filtration and fuel consumption, while easily addressed by standard alkaline cleaning. Deodorization presented harder to clean fouling, due to aggregating and layering, requiring specific cleaning procedures. Abnormal refining operations caused fouling, impairing equipment mechanical integrity and product quality, while avoidable with proper operation, demanded specific cleaning procedures. Sub-optimal particle filtration (clay) and separation (phospholipids) harmed downstream operations, leading to hard fouling. In order to avoid mechanical cleaning for the harder fouling occurrences, it has been tested and optimized in industrial scale different formulation of surfactants for enhanced alkaline CIP, as well as cleaning parameters (time, temperature and agitation). After optimization, it has been possible to find formulations and procedures that show clear advantages regular alkaline CIP, especially on removal of severely aggregated incrustation of phospholipids and bleaching clay on deodorizers and heat exchangers. Photographic records and videos have been registered after this procedure. More than 15 complete deodorization sections in Brazil have been

successfully cleaned with optimized formulation and set of parameters, avoiding unwanted mechanical disassembly and hazardous high-pressure jet cleaning.

Practical Considerations to Using Cavitation Technology in Oils & Fats Processing. Darren J. Litle, *Arisdyne Systems, Inc., USA*

A summary of process results utilizing controlled flow cavitation (CFC™) in the applications of degumming, neutralization, and transesterification of seed oils is presented. The reasons for enhanced performance, reduced environmental impact, observed reduction in necessary acid and/or caustic addition as well as decrease in oil loss, potential savings in steam consumption and decrease in maintenance opex is discussed and industrial scale examples from all geographies are given. The efficient removal of residual soaps, phosphorus, ffa and metals while minimizing and in some cases even eliminating the need for water washing or silica addition is also described. Finally, the power of controlled flow cavitation to reduce catalyst consumption, increase throughput, and reduce monoglyceride content in finished biodiesel is also described.

Innovative and Sustainable Enzymatic Surfactant Solution for Laundry Liquids. Vicente G. Oliveira and Elvis Barreto, *Oxiteno, Brazil*

The opportunities for the growth of laundry liquids in a market scenario are huge, however, price can be a barrier to entry for many consumers switching from powders. Despite of that, consumers will not compromise on performance; hence, formulations for these consumers require effective, sustainable and innovative ingredients in order to be competitive in this market. There is a new market order that demands sustainable technologies low on water and air quality impact, and also natural resources availability throughout product life cycle. Considering performance, enzymes and surfactants are key ingredients in a detergent for getting clothes clean and find out the synergy between these two important ingredients is crucial to deliver performance required by consumers. Though, in situations where the price of liquid detergents is still a barrier to entry, the use of enzymes could be a challenge. Consequently, the amount and type of enzymes used in formulations will vary by product depending on the target market, the stains to be removed and product claims. Given that enzymes can impact on the cost of the formulation, low cost brands will tend to contain fewer (if any) enzymes, while those that claim to have the greatest cleaning power will contain a wider variety of enzymes. Thus, the key challenges in laundry liquids are performance improvement together environmental benefits with reduced cost impact, enzymes stabilization and optimization in process/raw material. Oxiteno and Novozymes developed an enzymatic surfactant solution that addresses at the same time the three major issues faced by laundry liquid producers:

1) Cleaning performance in different target markets and solid environment benefits determined by life-cycle assessment when compare with market product (7% less impact climate change, 14% less human toxicity, 4% less aquatic eutrophication, etc.) evaluations with reduced cost impact (if any);
2) Improvement of enzyme stability in liquid detergents even at high water content;
3) Process simplification and optimization of raw materials.

Waste and effluent management and by-product value adding in oils and fat industry

Session Chairpersons: Sidney Leal, SL Process, Brazil and Serge Ghion Desmet Ballestra, Peru

Energy generation in multiseed crushing plant. Olivier Buyse and Bob Vandedrinck, *Vyncke, Belgium*

Energy costs represent a large portion of the operational costs and carbon footprint of edible oil plants, especially those fueled by fossil fuels. Meanwhile the associated crushing and milling operations produce large amounts of low value byproducts (waste streams) with significant energy content. The ability to convert these low value byproducts such as empty fruit bunches, palm kernel shells or sunflower hulls as well as other sources of low cost – locally available – biomass into steam and/or power enable these plants to significantly reduce their carbon footprint and reduce operational costs simultaneously. As the market becomes more competitive and the consumer is generally more conscious of the carbon footprint of the products they purchase, this ability is essential to maintaining competitiveness and market share. This talk will explore the state-of-the art technologies existing today to convert the byproducts into both thermal and electrical energy, the business case for such investment as well as looking deeper into some recent case studies around the globe.

Current situation for spent bleaching earth disposal. William J. Hausmann[1], Edson Hugler Villaseñor[2], and Arturo Hugler Quintanilla, *[1]The Core Team, USA; [2]Sonne Energeticos, Mexico*

Due to the rapid oxidation of the retained oil, spent bleaching earth is vulnerable to spontaneous combustion. Finding a safe, inexpensive and environmentally sustainable solution for disposal has long been pursued. Some integrated oilseed and edible oil processing facilities currently add the spent bleaching earth to meal. This method involves some risk and handling problems. The dominant practice worldwide is to use solid waste disposal involving prompt coverage with soil to prevent combustion. By mixing SBE with sufficient feed-grade salt and/or lime to eliminate the spontaneous combustion hazard and adding other desired ingredients, high-energy nutritional products can be produced for livestock and poultry feed at an especially competitive cost. This patented process can be utilized for nearly any type of livestock or poultry. A University of Missouri feeding study was conducted on cattle, and the UANL recently completed a poultry feeding study. Both studies demonstrated significant advantages and no negatives. Horse owners have also reported benefits when given samples of salt-lick blocks made with spent bleaching earth. Current status of commercialization in Latin America and the potential benefits to LatAm livestock, poultry, and feed industries will be discussed.

Optimización de efluentes líquidos en plantas de biodiesel. Guillermo Fernández Long, *Bioxxar, Argentina*

Mediante la implementación de un sistema de concentrado de efluentes integrado al sistema de recuperación de metanol, se ha logrado reducir el consumo de vapor, siendo el mismo el equivalente al de cada uno de dichos sistemas por separado. Ese ahorro asociado a un manejo del concentrado que es enviado al tratamiento de glicerina para su recuperación, y sumado a la condensación de los vapores produciendo agua caliente de calidad (sin necesidad de emplear un condensador con agua de torre, y/o sistemas de múltiples etapas), hacen al sistema sencillo y fiable. El sistema se auto regula conforme la cantidad de agua de lavado

empleada en el proceso. El agua que no es re utilizada en la etapa de lavado se emplea en la dilución de soda cáustica de la etapa de pretratamiento, o bien en la fluidificación de las borras a la salida del separador centrífugo de pretratamiento. Mitigación del impacto ambiental **por Ton de biodiesel** (comparado a un sistema de 2 etapas) Ahorros • 35 – 50 Kg de vapor • 0,24 m3 de agua tratada a reponer en torres de enfriamiento • 3,2 Kwh de energía eléctrica • 6,4 lts. de efluente a disponer • 9,5 a 12,5 Kg de CO2 (sin considerar la disminución asociada al ahorro de energía eléctrica – depende de su fuente de generación-) En síntesis, el ingenioso sistema contribuye a reducir la huella de agua y la huella de carbono de una unidad con efluente acuoso en general, y en el caso de las unidades de biodiesel, integración energética mediante, permite ir hacia un sistema "cero efluente".

Soapstock Splitting. Serge Ghion, *Desmet Ballestra, Peru*

Abstract not available.

Evaporation technology applied on waster water treatment. Adriana M. Andrade, *GEA Equipamentos e Soluções, Brazil*

In nearly every industrial production process, water is used for different applications such as i.e. process water, washing water, rinsing water, scrubbing water, dilution water, leaching water, or it is even part of the product that is processed. This implies that large quantities of industrial waste water with strong contamination of different composition are produced.
It is essential for our Environment to find solutions to treat and recovery the waste water, taking in consideration the limited fresh water resources and waste water streams can cause contaminations. Besides that, a reasonable loss of valuable product may occur if the waste stream if it is not treated accordingly.
Presentation shows Evaporation Technology, as a Thermal Separation Process to deal with this kind of stream, as well the most cost-efficient concept applied for that.

Recovery of micro-nutrients from deodorizer distillates. Mohammad S. Alam, *Texas A&M University, USA*

Tri-acyl glycerol" (TAG) is the major fraction of crude vegetable oil including various undesirable components such as gums, pigments, free fatty acids, metals, mono-acyl glycerol (MAG), di-acyl glycerol (DAG) and many essential micro-nutrients. Refining of crude oil is essential for removing the undesired components for longer self-life and product stability. However, the refining process also removes some of the essential micro-nutrients also called deodorizer distillates during the last step of oil refining process. Deodorizer distillates (DD) are important by-products but normally ends up in animal feeds or being discarded depending on oil type and quality. Important micro-nutrients such as tocopherols, phytosterols, polyphenols, squalene are considered to help protect against cardiovascular disease and cancer including anti-oxidation, blood cholesterol regulation and enhanced calcium absorption. These micronutrients are also being used in various food formulation, pharmaceuticals and cosmetics. Unfortunately, not much attention has been paid in recovering these healthy and essential micro-nutrients perhaps due to the lack of technology or economic feasibility. Recent advancements in oil refining process including new instrumentation's and analytical procedures

may open opportunities to divert attention and resources in this area. Separating of these micro-nutrients into individual fractions is still a challenge. Several new methods including enzymatic process, membrane application, chemical process has been employed to isolate and analyzed unsuccessfully. The fats and oils department at Texas A&M has been involved for decades in processing specialty oils and their by-products. In this presentation some of the challenges and opportunities will be discussed. References: Setiyo Gunawan and Yi-Hsu Ju. Vegetable Oil Deodorizer Distillate: Characterization, Utilization and Analysis. Separation and Purification Reviews, 38: 207-241, 2009. Frederic Fine, Claire Brochet, Marie Gaud, Patrick Carre, Noemie Simon, Fatima Ramli and Florent Joffre. Micronutrients in Vegetable Oils. The impact of crushing and refining processes on vitamins and anti-oxidants in sunflower, rapeseed and soybean oils. Review article. Eur. J. Lipid Sci. Technol. 2016, 118, 680-697. Syed Tufail Hussain Sherazi, Sarfaraz Ahmed Mahesar and Sirajuddin. J. of Oleo. Sci. 65, (12) 957-966 (2016).

Functionality in Food Posters

1. Study of the non-linear rheological response of palm stearin-palm kernel oil mixture Elena Dibildox Alvarado*[1], GABRIELA AVILA-DE LA ROSA[2], JAIME D. PÉREZ-MARTÍNEZ[3], and Jorge F. Toro-Vazquez[1], *[1]Universidad Autónoma de San Luis Potosí, Mexico; [2]UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ; [3]Lab. Biopolímeros Alimentarios, Facultad de Ciencias Químicas, Universidad Autónoma de San Luis Potosí, Av. Manuel Nava No. 6, 78210, México., Mexico*

Palm oil and the mixtures of its different fractions have a mechanical response that is difficult to fully characterize by linear rheological tests. For this reason, it was studied the non-linear rheology of a palm stearin-palm kernel oil mixture in proportion 70-30, whereas interesterified or uninteresterified as well as a margarine elaborated with the interesterified mixture. The above, with the aim of finding the change in the mechanical response of the material in the different stages from raw material to finished product. For this, oscillatory tests were carried out with wide deformations at a constant frequency in the non-linear regime, and in addition, the size of the crystal was measured before and after the tests. ALL measurements were carried out at the temperature where the samples are plastic. Data from oscillatory measurements were processed with the Fourier Transform and dissipation energy was calculated. It was found that interesterified fat is a weaker material with a very broad nonlinear region that begins to present at ≈0.01% deformation. While the non-linear region of non-interesterified fat and margarine starts an order of magnitude later (0.1% deformation). The presence of higher harmonics confirmed the development of the non-linear regime of the samples. Finally, it was found that in the non-linear region, both the margarine and the non-interesterified mixture behave like a plastic solid while the non-interesterified fat tends to the response of a fluid.

3. Enzyme catalyzed synthesis of phytosteryl esters in deep eutectic solvents Nicolas Callejas[1], Elisa Volonterio[2], Bruno Baréa[3], Erwann Durand[3], Claire Bourlieu[4], Jerôme Lecomte[5], Pierre Villeneuve[6], Maria Cruz Figueroa-Espinoza[7], and Iván Jachmanián*[1], *[1]UdelaR, Uruguay; [2]Facultad de Química, Universidad de la República, Uruguay; [3]CIRAD, France; [4]UMR IATE - INRA/CIRAD/UM2/SupAgro, France; [5]CIRAD, Greece; [6]UMR IATE, CIRAD, France; [7]Montpellier*

SupAgro, UMR IATE, Montpellier , France

Enzyme catalyzed synthesis of phytosteryl esters in deep eutectic solvents: The efficiency of lipase from Candida rugosa in the synthesis of phytosteryl esters from a blend of phytosterols and vinyl laurate was studied in three different deep eutectic solvents (DES). Solvents were prepared by combining choline chloride (ChCl) with three different hydrogen bond donors in the adequate proportion: 1,4-butanediol (DES1), glycerol (DES2), and isosorbide (DES3). Reactants, solvents, and catalyst were incubated at 45 ºC under stirring at 200 rpm in an orbital shaker. Alternatively, incubations were performed by adding 0, 4 or 8 wt% water to DES or using hexane as solvent (for the positive reference). Samples of the reaction mixture were collected every 24 h until 6 days, which were destined to gas chromatography analysis in order to determine phytosterols conversion rate. Results showed that the lipase was active in all the DES media used. The maximum conversion rates were achieved after 24 h reaction in non-hydrated DES: 9 (DES1), 43 (DES2), and 48 % (DES3). While 8 % water addition to DES1 and 4 % water addition to DES2 increased the conversion to 42 and 93 %, respectively, both water levels negatively affected the conversion achieved in DES3. Conversely to results obtained in DES media, when the reaction was performed in identical conditions but using hexane as solvent, a continuous rising conversion was observed until 6 days of reaction, with a 81 % conversion rate after 24 h. Thus, phytosterols conversion rate was better after 24 h of reaction in 4% (w/w)-DES2 than in hexane. According to results the studied DES could represent an alternative green reaction medium for the synthesis of phytosteryl esters, bioactive compounds of major interest for the food industry.

4. Hybrid palm oil feature better oxidative stability than African palm oil under different oxidation temperatures. Luana O. de Oliveira*[1], Rafael C. Sales[2], Patrícia C. de Velasco[2], Maria das Graças T. do Carmo[2], and Vanessa N. Castelo-Branco[1], *[1]Federal Fluminense University, Brazil; [2]UFRJ, Brazil;*

Palm hybrid oil feature better oxidative stability than African palm oil under different oxidation temperatures The present work investigated the oxidative stability of hybrid palm oil (HPO) and african palm oil (APO) at 65 ºC and 180 °C for 7 days and 24 hours, respectively. At 65 ºC, aliquots (50 mL, in duplicate) were removed on 1, 3, 5, and 7 days and, at 180 ºC, on 3, 6, 12 and 24 hours. Oxidative stability was monitored by acid, peroxide and p-anisidine values. During oxidation at 65 ºC, acid value increased 70% in APO between 0-7 days while remained constant in HPO. Similarly, peroxide value increased 25% in APO between 5-7 days while remained constant in HPO. However, p-anisidine value increased 35% in APO between 0-1 day, remaining constant until the end-point of oxidation meanwhile HPO showed a gradual increased, reaching 91% of increase at end-point of oxidation. During oxidation at 180 ºC, acid value increased 84% and 30% in APO and HPO, respectively. Peroxide value showed an initial increase of 107% in APO, followed by a reduction between 6-24 hours, while HPO increased 133% between 3-24 hours, suggesting that both oils showed higher instability. However, APO was in a more advanced oxidation stage. Finally, increase in p-Anisidine value was markedly higher in APO than in HPO at 180 °C. In conclusion, hybrid palm oil showed the best oxidative stability in varied oxidation mechanisms, probably allowing a wide range of applicability on food industry.

5. Development of EDTA alternative for food emulsions. Joan Randall[1], Lan Ban[1], Yvonne Gildemaster[1], and Chandra Ankolekar*[2], *[1]Kemin Food Technologies, USA; [2]Kemin Industries Inc., USA*

Due to a move towards more "clean-label" ingredients there is an industry demand for an EDTA alternative for acidic processed food, such as food emulsions (mayonnaise, spreads, dressings, and sauces) and acidic beverages. EDTA acts as a strong antioxidant in these types of food systems through its metal ion chelating capabilities, while most known organic acids cannot chelate in acidic aqueous solutions. Despite much effort spent on identifying a natural chelator, there hasn't been one identified for the food industry. In this study, an alternative approach was taken with the aim of matching the antioxidant efficacy of EDTA. A series of ingredients with potential antioxidant capabilities were screened in a model food emulsion system and a few key ingredients were identified and further optimized through a Design of Experiment (DOE). A blend of rosemary, spearmint and green-tea extracts was developed, which improved the oxidative stability of mayonnaise. Of the ingredients screened so far, this blend was closest in performance to the upper legal limit of EDTA (75 ppm). The blend was developed from this study and validated for performance in two representative food emulsions systems. The validation data did not reveal a dose response between the blend at 1000 ppm and at 2200 ppm, indicating that lower dosage could also achieve satisfactory improvements.

6. Role of modified milk fat as structurant of lipid bases. Mayara S. Queirós*, Rodolfo L.S. Viriato, Ana Paula B. Ribeiro, and Mirna L. Gigante, *University of Campinas, Brazil*

Role of modified milk fat as structurant of lipid bases The objective of this work was to evaluate the potential of fully hydrogenated milk fat (FHMF) as a modulator of the crystallization of lipid bases with 10, 20, 30, 40 and 50% w/w of high oleic sunflower oil (HOSO) through thermal behavior, microstructure and polymorphism. In the crystallization, additions greater than 30% of HOSO resulted in the second crystallization peak (-30 to -54 °C), associated to a reduction of the enthalpy. In the melting, in addition to the FHMF peak, all lipid bases showed a second peak characteristic of the fusion of triunsaturated triacylglycerols from HOSO. Consequently, more liquid oil was observed in the crystalline network, which resulted in the reduction of the crystallized area. This crystal structure was composed of spherulites with high degree of molecular organization, called malt cross. As for polymorphism, the preferential crystalline habit of FHMF in β' was maintained, even in systems with 50% HOSO, which crystallizes preferentially in the β form. This set of physical properties are important for application, since β' crystals are softer and can provide better sensory quality. In summary, the physical properties resulting from the chemical composition of FHMF governed the crystallization and melting processes of the lipid bases. FHMF was able to structure up to 50% HOSO in the systems, suggesting a potential application as an ingredient in formulations or lipid phase of microparticulate or nanostructured systems.

7. Encapsulación de vitamina C en emulsión doble tipo crema. María P. Pérez[1], Jorge Wagner[2], and Andrés L. Márquez*[1], *[1]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos (LIFTA), Universidad Nacional de Quilmes; CONICET, Argentina; [2]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos, Dept. de Ciencia y Tecnología, Universidad Nacional de Quilmes, Argentina*

El objetivo fue evaluar la capacidad de una emulsión doble ($W_1/O/W_2$) símil crema de leche para encapsular vitamina C. Inicialmente se preparó una emulsión W_1/O empleando grasa vegetal interesterificada como fase lipídica e incluyendo ácido ascórbico en la fase acuosa dispersa. La emulsión $W_1/O/W_2$ se preparó por homogeneización de leche vacuna descremada y 20% p/p de emulsión W_1/O, obteniéndose un sistema con 10 mg de ácido ascórbico/100 g. Una emulsión simple (O/W_2) fue preparada como control. La determinación del porcentaje de vitamina C en la fase acuosa continua se realizó por titulación con 2,6-diclorofenol-indofenol. La eficiencia de encapsulación (EE), como parámetro de retención de fase acuosa dispersa en la emulsión $W_1/O/W_2$, fue estimada mediante calorimetría diferencial de barrido. Luego de 1 día de almacenamiento refrigerado, se detectó 52,7% de vitamina C liberada en la fase continua de la emulsión $W_1/O/W_2$, mostrando buena correlación con la EE (46,4%, o sea 53,6% de fase acuosa dispersa liberada). En el mismo tiempo, se midió 90,4% de vitamina C en el sistema control. Estos datos indican que casi la mitad de la vitamina adicionada pudo ser encapsulada. La cantidad de ácido ascórbico detectado disminuyó progresivamente en ambas emulsiones, llegando a un valor casi nulo luego de 1 mes, debido a la degradación de la vitamina. No obstante, la EE fue de 43,1% tras ese tiempo, indicando que posiblemente un porcentaje similar de vitamina fue aislado y protegido. Los resultados señalan que la emulsión $W_1/O/W_2$ puede ser útil para encapsular y, eventualmente, proteger vitamina C.

7. Encapsulation of vitamin C in cream-like double emulsion. María P. Pérez[1], Jorge Wagner[2], and Andrés L. Márquez*[1], *[1]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos (LIFTA), Universidad Nacional de Quilmes; CONICET, Argentina; [2]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos, Dept. de Ciencia y Tecnología, Universidad Nacional de Quilmes, Argentina*

The objective was to evaluate the capability of a dairy cream-like double ($W_1/O/W_2$) emulsion to encapsulate vitamin C. Initially, a W_1/O emulsion was prepared with interesterified vegetable fat as lipid phase, including ascorbic acid in the dispersed aqueous phase. The $W_1/O/W_2$ emulsion was prepared by homogenization of skimmed cow milk and 20% w/w of W_1/O emulsion, obtaining a system with 10 mg ascorbic acid/100 g. A simple (O/W_2) emulsion was prepared as control. The determination of vitamin C percentage in the continuous aqueous phase was made by titration with 2,6-dichlorophenolindophenol. The encapsulation efficiency (EE), as a parameter of retention of dispersed aqueous phase in the $W_1/O/W_2$ emulsion, was estimated by differential scanning calorimetry. After 1 day at refrigerated storage, it was detected 52.7% vitamin C liberated in the continuous phase of the $W_1/O/W_2$ emulsion, showing good correlation with EE (46.4%, or 53.6% dispersed aqueous phase that was liberated). At the same time, 90.4% vitamin C was measured in the control system. These data indicate that almost half of the added vitamin could be encapsulated. The detected quantity of ascorbic acid diminished progressively in both emulsions, reaching an almost null value after 1 month due to the degradation of the vitamin. However, EE was 43.1% after that time, indicating that possibly a similar percentage of vitamin was isolated and protected. The results point out that the $W_1/O/W_2$ emulsion may be useful to encapsulate and, eventually, protect vitamin C.

9. Chemical characterization of simple and interesterified soybean oil and fully hydrogenated microalgae oil blends. Kamila R.R. Godoi, Ana Paula B. Ribeiro, Mayanny G. Silva, *University of Campinas, Brazil*

Chemical characterization of simple and interesterified soybean oil and fully hydrogenated microalgae oil blends The chemical interesterification of oils blends represents the most versatile option for the lipid basis production with differentiated physicochemical proportions and more applicability in foods. The present work aims to characterize chemically blends of fully hydrogenated microalgae oil (FHMO) and soybean oil (SO) in the 50:50, 60:40, 70:30, 80:20 e 90:10 (FHMO:SO w:w) proportions in simple and chemically interesterified forms. The quantified parameters were fatty acid composition, triacylglycerols composition, calculated iodine and saponification index. The SO showed predominance of unsaturated fatty acids (84.76±2.62%); the FHMO was totally characterized by saturated fatty acids (99.94%±0.10, stearic acid: 92.85±0.10) while the blends simple and random showed proportional composition. The iodine and saponification index of the raw materials were, respectevely: 129±2.64 I2/100g and 193±42.66 mgKOH/g for SO and 0.33±0.07 I2/100g and 190±5.44 mgKOH/g for FHMO. The random distribution of the fatty acids during the chemical interesterification promoted the formation of new triacylglycerols without modifications in fatty acid composition. In our blends, the trisaturated, disaturated and monosaturated groups decreased respectively: 5%, 1.1% and 4.4% for 90:10 (w:w) blends, 4.8%, 4.3% and 13% for 80:20 (w:w), 13,5%, 7.3%, 13.2% for 70:30 (w:w), 17.3%, 7.2% and 18.9% for 60:40 (w:w) and 17.3%, 7.4% and 25.1% for 50:50 (w:w), while the dissaturated groups increased proportionally to the FHMO:SO proportion to 10.5% until 49.06% to 90:10 (w:w) until 50:50 (w:w) blends. Therefore, the chemical interesterification applied in these unexpected matrices became possible modify the triacylglycerols composition, physical and crystallization characteristics of these lipid blends expanding the possibilities to application in foods.

10. Chemical characterization of interesterified hardfats-soybean oil blends. Mayanny G. Silva*, Kamila R.R. Godoi, and Ana Paula B. Ribeiro, *University of Campinas, Brazil*

Chemical characterization of interesterified hardfats-soybean oil blends The present work evaluated the effect of chemical interesterification on composition of binary blends (50:50 %w/w) of fully hydrogenated oils, palm kernel (PKO), palm (PO), soybean (SO), microalgae (MO) and crambe(CR) with soybean oil. The sodium methoxide powder was used as a catalyst for the reaction, the content used was 1.0% and the reaction was conducted under vacuum at 100°C, with stirring at 500 rpm, for 20 min.The fatty acids and triacylglycerol composition analyzes were performed in capillary gas chromatograph GC Agilent 6850 Series GC System. Iodine value and saponification values were calculated according to the official methods of the American Oil Chemists' Society - AOCS. The acyglycerol classes were determined by high-performance size exclusion chromatography. The fatty acid composition, iodine values, and saponification calculated for the blends were proportional to the amounts of each component of which the blend is composed. The percentages of saturated fatty acids in the blends ranged from 56% to 58%. The chemical interesterification was able to maintain the structure of the triacylglycerols after the reaction, without significant formation of partial glycerides and free fatty acids. The interesterification reaction produced substantial rearrangement of the triacylglycerol species in all blends, reduction in trisaturated triacylglycerol content and increase in monounsaturated–disaturated and diunsaturated–monosaturated triacylglycerol classes. The production of interesterified fats expand their applications, and a comprehensive understanding of the composition and physical properties is essential to outlining applications for them and obtaining food products with the desired final

attributes.

11. Effect of oil type on candelilla wax oleogel systems. Emmanuele Di Fabio[1], Luiz A. Gioielli[1], Elena Dibildox Alvarado[2], and Juliana N.R Ract*[1], *[1]University of Sao Paulo, Brazil; [2]Universidad Autónoma de San Luis Potosí, Mexico*

Effect of oil type on candelilla wax oleogel systems The challenging possibility of turning liquid oils, low in saturated and *trans* fatty acids, into a semisolid material similar to fats with high functionality makes the oleogels a promising system to be investigated. The objective of this study was to evaluate the oleogelating capacity of candelilla wax (CW) in different lipid sources. The oleogels were prepared with 1.5, 3.0 and 6.0% (w/w) CW dispersed in medium chain triacylglycerols, high oleic sunflower oil, sunflower oil, linseed oil, ARASCO® and DHASCO®. The oleogels firmness was measured in a texture analyzer (TA.XT Plus, Stable Micro Systems) and the oils were characterized for fatty acid composition, iodine and saponification values, free fatty acids, viscosity, density, and interfacial tension. All the analyses were performed at 20 °C. Among these parameters, viscosity, density, and saponification value were the factors that presented a statistically significant correlation with the firmness of the gels. All the oils showed a Newtonian behavior and lower viscosity oils resulted in stronger gels, revealed by a negative correlation (r^2 = -0,71) and (r^2 = -0,82) for oleogels with 1.5 and 6.0% CW, respectively. The density of the oils showed a positive correlation (r^2 = 0,70) and (r^2 = 0,86) with the gels firmness at the same concentrations. Oils with higher saponification values resulted in firmer gels, with a significant correlation (r^2 = 0,87) for oleogels with 6,0% CW. In conclusion, specific properties of each oil are factors that can influence the formation of the structured network.

27. Lipid nanoparticles formulated with conventional vegetable oils and fats: physical properties and stability. Marcella Stahl, Fernanda Ludtke, Renato Grimaldi, Mirna Gigante, Juliana Hashimoto, and Ana Paula Badan Ribeiro, *University of Campinas, Campinas, Brazil*

Lipid nanoparticles (LN) can be produced with conventional fats and oils, generating greater interest for food industries. The use of edible products in nanoscale can offer high functionality compared to conventional encapsulation systems. LN are considered versatile because structure, dimensions, carrying capacity and physical state can be controlled through the choice of specific raw materials. This study showed LN produced with high oleic sunflower oil (HOSO) oil and fully hydrogenated soybean oil (FHSO), with modified soy lecithin**,** emulsifier widely used in foods. Two LN were produced: a solid lipid nanoparticle (SLN) formulated with 5%(w/w) of FHSO, 95%(w/w) of ultrapure water and a nanostructured lipid carrier (NLC) produced with 10%(w/w) of FHSO:HOSO in 60:40(w:w) proportion, 90%(w/w) of ultrapure water, both with 2%(w/w) of emulsifier in aqueous fraction. The pre-emulsions were heated above the melting point of the lipid fraction, subjected to ultraturrax homogenization, subsequently processed by high pressure homogenization (HPH) at 700bar and 2 cycles, and stored at 25°C. The evaluated parameters were particle size (PS), zeta potential (ZP) and physical stability by Turbiscan, 1 and 15 days after obtaining LN. PS indicated 175nm and 151nm for SLN, and 208nm and 231nm for NLC after 1 and 15 days, respectively. PZ was up ±50mv for SLN and NLC, indicating low tendency to aggregation in the system. This high stability was confirmed by the Index Stability Turbiscan (IST), less than 5%; IST lower than 10% represent low instability values. These parameters are the most important for characterization of LN and,

according to the results, SLN and NLC proved stable for incorporation into processed foods, for example, to load bioactive compounds.

Health and Nutrition Posters

12. Ácidos grasos en semillas de variedades de Sesamum indicum de interés socioeconómico para el Paraguay. Laura G. Mereles[1], Eva Eugenia Soledad Coronel Mendez[2], Natalia Martinez[3], Silvia B. Caballero[4], and María Cristina Romero[5], *[1]Universidad Nacional de Asunción. Facultad de Ciencias Químicas., Paraguay.; [2]Universidad Nacional de Asunción, Paraguay; [3]UdelaR, Uruguay; [4]Universidad Nacional de Asunción, Facultad de Ciencias Químicas., Paraguay; [5]Universidad Nacional de Asunción, Facultad de Ciencias Químicas, Dpto. de Química Biológica., Paraguay*

Ácidos grasos en semillas de variedades de Sesamum indicum de interés socioeconómico para el Paraguay El contenido de lípidos y el perfil del aceite juegan un importante papel en la calidad del sésamo. El presente trabajo tuvo como objetivo analizar el contenido de lípidos totales y el perfil de Ácidos Grasos (AG) en el aceite de 10 variedades de Sesamum indicum desarrolladas en Paraguay con interés socio-económico. Se determinaron los siguientes parámetros: humedad (método AOCS Ca2b-08), lípidos totales y perfil de ácidos grasos (método AOCS Ce 2-66)por GC/FID. Para determinar significancia estadística se utilizó ANOVA y test de Tuckey a posteriori ($p>0,05$). No se observaron diferencias estadísticamente significativas en el contenido de lípidos totales entre las 10 variedades. El contenido de lípidos totales varió de 49,19-56,35 g/100g de semilla. En el perfil de ácidos grasos del aceite se observó que el ácido graso mayoritario fue el ácido linoleico (44,60-52.61%) en todas las variedades estudiadas, el cual constituye un ácido graso esencial Ω6, seguido por el ácido oleico (32.69-40.91%) y en menor proporción se observaron; ácido palmítico (8,54-10,51%), esteárico (4,34-4,84%), linolénico Ω3 (0,22-0,31%) y araquidónico (0,22-0,23%). Se observó diferencias significativas en el contenido de los ácidos linoleico, linolénico y oleico. El aceite de las semillas de la variedad M1 presentó el mayor contenido de ácido linoleico C18:2 Ω6 (27,02±0,08mg/100g de semilla), por otra parte, la variedad M6 presentó el mayor contenido de lípidos totales (56,35±2,16g/100g), en general el contenido del ácido graso mayoritario (C18:2 Ω6) no se correlaciona con el mayor contenido de lípidos totales para la misma variedad, estos resultados indican que la genética de cada variedad podría influir en el perfil de ácidos grasos esenciales en las semillas de sésamo. Este trabajo constituye el primer dato en el cual se relaciona el perfil de ácidos grasos con la variabilidad genética de la especie en estudio, se establecen datos preliminares para apoyar programas de fitomejoramiento, con valor agregado en función a la composición y perfil de ácidos grasos en el aceite de las semillas de sésamo producidas en Paraguay.

13. Lipid composition of Brazilian commercial margarines Thaís Jordânia*, and Daniel Barrera-Arellano, *Laboratorio de óleos e gorduras, FEA, UNICAMP, Brazil*

The prohibition, in some countries, of the use of partially hydrogenated fats introduced a major challenge for food research, including margarines, due the modification their lipid profile by the use of alternative fats. The objective of this work was to evaluate the physico-chemical composition of Brazilian commercial margarines, indicating their lipidic profile, and

the compliance with the nutritional information contained in their labels. Thirteen margarine samples were purchased in local market and evaluated their fatty acids composition, solid fat content, melting point and texture properties according to AOCS official methodology. The present study was conducted with margarines with total fat content between 20-82%, in order to include margarines of low and high lipid content. Except for two samples (approximately 5-7% of elaidic acid), all margarines presented low levels of trans fatty acids (TFA), allowing the declaration "zero trans" in the labels. The lipid phases had similar fatty acids composition, being mostly linoleic acid (~ 23-46%), oleic acid (~ 20-46%), palmitic acid (~7-14%), and saturated fat content between 23-31%. Despite the differences in lipid content of the margarine, all lipid phases showed similar solids profile, with melting point between 22-28°C. Margarines with TFA showed more plastics. Margarines with higher lipid content and saturated fatty acids, showed higher values of hardness, spreadability, viscosity and adhesiveness. Still it's possible to find table margarines with high TFA content, containing partially hydrogenated fat, in the Brazilian market. Margarines produced in Brazil basically contain interesterified fats from totally hydrogenated soybean fats and soybean oil.

Processing and Refining Posters

17. Physical properties of oleogels as affected by high intensity ultrasound, cooling rate and storage conditions. Anabella S. Giacomozzi[1], Camila Palla[2], María E. Carrín[2], and Silvana Martini[3], *[1]Universidad Nacional del Sur, Argentina; [2]Departamento de Ingeniería Química (DIQ) - Universidad Nacional del Sur (UNS), Argentina; [3]Utah State University, USA*

Monoglyceride (MG) oleogels were formulated with the aim to study the effect of MG concentration (3, 4.5, and 6%), HIU application (20kHz, 10s on/5s off), cooling rate (0.1 and 10ºC/min), and storage temperature (5 and 25ºC) on physical properties of the materials. Samples were placed in a crystallization cell set at different crystallization temperatures (Tc = 38, 41, and 45°C for 3, 4.5 and 6% MG samples, respectively). Samples were cooled to Tc at 0.1 and 10ºC/min and then cooled to 5 or 25ºC. Physical properties, such as oil binding capacity (OBC), hardness (HA), elasticity (G'), microstructure, melting profile and solid fat content (SFC), were measured after storage (24h).

A significant increment ($p<0.05$) in HA, OBC, and G' values were observed due to HIU application for both cooling rates This effect was enhanced after storage at 5°C. A significant decrease ($p<0.05$) in HA and OBC values was observed when samples were crystallized at the slow cooling rate. The highest HA and OBC values were found for 6% MG sonicated samples crystallized at 10ºC/min and stored at 5ºC, being 1.1±0.1N and 94.0±1.0%, respectively. In general, higher cooling rate increased the elasticity of non-sonicated samples, whereas sonicated samples exhibited a decrease in G' values when the cooling rate increased from 0.1 to 10ºC/min. HIU application reduced crystals size while melting behavior and SFC were not affected by neither HIU nor cooling rate.

These results indicate that HIU offers a potential way to tailor the physical properties of monoglyeride oleogels.

28. Chemical interesterification of macauba pulp oil with fully hydrogenated macauba almond oil. Larissa Magalhães Grimaldi, Caroline Lopes, Renato Grimaldi, and Ana Paula Badan

Ribeiro, *Dept. of Food Technology, Faculty of Food Engineering University of Campinas (UNICAMP), Brazil*

Macauba (*Acronomia aculeata*) is one of the most promising palm trees in Brazil as a source oil for food, cosmetics and fuel industry, due to its high productivity and oil content. The main fatty acids in pulp oil are 56.72% oleic acid (C18:1) and 20.41% palmitic acid (C16:0) and, for the almond oil, 41.68% stearic acid (C18:0) and 35.17% lauric acid (C12:0). The interesterification process of oils and fats modifies the melting and crystallization behaviors and reduces the recrystallization tendency during the shelf life. Thus, the aim of this work was to apply the chemical interesterification (100^{o}C, 20 minutes, 500rpm) to a macauba pulp oil (50%) and fully hydrogenated macauba almond oil (50%) blend to obtain a product with different physical characteristics and to evaluate some parameters through official methodologies (AOCS, 2009) for consistency (*yield value*), thermal behavior (DSC) and triacylglycerol composition analysis. The *yield value* was 19.05 gF/cm^2 and after the interesterification reaction became 8.07 gF/cm^2. Regarding the triacylglycerol composition, the simple blend had 28.73% intermediate chain triacylglycerols (C42 to C48) while after interesterification the vale was 75.70%. These results are in accordance with the crystallization profile obtained by DSC, since the interesterified blend showed three peaks and a wide crystallization range (-40^{o}C to 23^{o}C) was observed, proving the formation of new triacylglycerol molecules.

Quality Control and Analytical Techniques Posters

18. Estudio comparativo del deterioro termoxidativo del aceite de girasol entre presión atmosférica y reducida. Nadia Segura[1], Jimena Lázaro[1], Natalia I. Martinez*[2], and Bruno Irigaray[3], *[1]Facultad de Química, Uruguay; [2]Fac Química, UdelaR, Uruguay; [3]UdelaR, Uruguay*

Estudio comparativo del deterioro termoxidativo del aceite de girasol entre presión atmosférica y reducida Los avances tecnológicos han permitido el desarrollo de una nueva forma de fritar con el uso de presión reducida. La misma permite obtener alimentos con características similares a la fritura tradicional, pero con un menor contenido de lípidos. Pueden encontrarse en el mercado distintos tipos de vegetales en chips elaborados con esta tecnología. En el presente trabajo se estudió la evolución del proceso de termoxidación del aceite de girasol bajo diferentes condiciones: 180ºC y presión atmosférica (condiciones de fritura convencional) (TPA) vs 130ºC y 90 torr (condiciones de fritura a vacío) (TPR). La TPA se prolongó por un total de 24 h, mientras que la TPR por 500 h. En ambos casos, se realizaron muestreos periódicos del aceite para determinar el contenido de polímeros (Wolff et al., 1991), compuestos polares (IUPAC 2.507 modificado), valor de peróxidos (AOCS Cd 8-53), y concentración de tocoferoles (Andrikopoulos et al., 1991). Se observó el aumento de los compuestos polares y los polímeros totales en ambas condiciones, alcanzando valores de 26 y 13%, y, 20 y 4%, a TPA y TPR, respectivamente. Asimismo la pérdida de tocoferoles fue de un 35 y 20% a TPA y TPR, respectivamente. En cuanto al valor de peróxidos, tal como se esperaba, no alcanzó valores altos en ninguno de los dos casos, 7,1 y 3,5 meqO2/Kg para TPA y TPR, respectivamente. En conclusión, la termooxidación del aceite de girasol bajo condiciones de presión reducida preserva la calidad del aceite por un tiempo más prolongado.

19. Oxidative stability evaluation of vegetable soybean oil with added rosemary extract. Daiane Magro*[1] Lorena B.B Tavares[2], and Sávio L. Bertoli[2], *[1]Bunge, Brazil; [2]FURB, Brazil*

Oxidative stability evaluation of vegetable soybean oil with added rosemary extract. Soybean vegetable oil may present a shorter shelf life due lipid oxidation. However, natural antioxidants such as rosemary extract can prevent or delay this oxidation. In recent years, natural compounds with antioxidant potential have been suggested as an alternative source to traditional synthetic antioxidants. The main goal of this study was to evaluate the effect of the addition of different concentrations of rosemary extract in soybean vegetable oil and its storage temperature. Samples of soybean vegetable oil containing 100, 200 or 300 ppm of rosemary extract were stored at 25, 35 or 45 °C. The evaluation of samples was continued for 120 days, at 30-day interval, and followed the official method AOCS Cd 12b-92 and TOTOX. It was observed that Temperature is the higher propellant of lipid oxidation. Thus, greater oxidative stability was observed in the samples stored at 25°C, followed by samples stored at 35°C and finally by the samples stored at 45°C. When we evaluated the results of the samples looking at the different antioxidant concentration, it was possible to verify that the higher concentration of the antioxidant didn't give a significant increase in the shelf life of the samples. In other words, 200 or 300 ppm of rosemary extract resulted in a similar soybean vegetable oil shelf life. Then, it was concluded that a 25°C storage temperature, with the addition of 200 ppm of rosemary extract, is sufficient to secure the expected soybean vegetable oil shelf life.

20. Quantification of citric acid added in vegetable fats and oils during deodorization process by spectrophotometer. Daiane Magro*, Thiago Zarrilli, Juliana Cecchet, and Jean R. de Souza, *Bunge, Brazil*

Quantification of citric acid added in vegetable fats and oils during deodorization process by Spectrophotometer. Citric acid is used in deodorization process as a synergist antioxidant and chelating agent. The main goal of this study was to develop a simple, precise and reproducible quantitative method to evaluate the procedure of adding citric acid in vegetable oils during deodorization process by spectrophotometer. The method developed has followed three steps: extraction, reaction and quantification. The extraction procedure is completed in about 10 minutes using hexane and water. An aliquot of the extract is reacted with pyridine and acetic anhydride in a water bath at 32°C for 30 minutes and the quantification is executed by measuring the absorbance at 428nm against a standard calibration curve in a spectrophotometer. The method detection limit is 1.1mg/kg and the recoveries of citric acid from oil vary between 97 and 103%. The evaluation of samples containing citric acid followed two steps: dilution of citric acid in water and concentration of citric acid added in vegetable oils. The dilution of citric acid in water was checked in 5 levels (0.17, 0.22, 0.30, 0.50 and 1.50%) and the best results were obtained when it was diluted at 0.30 and 0.50%. The concentration of citric acid in oil was analyzed in 4 levels (25, 50, 100, 300mg/kg) and the best results were found when the concentration reached up until 50mg/kg. It was observed that from 100mg/kg, a recrystallization of the citric acid occurs on the reactor walls, resulting in loss of material and lack of citric acid content in the oil.

21. Composition of Caiaué oil produced in Brazil. Adelia F. Faria-Machado[1], Rosemar Antoniassi[1], Andréa M. Guedes*[1], Roberto Y. Yokoyama[2], Jean M P Lourinho [3], and Mariana T. Ferreira[4], *[1]Embrapa Food Technology, Brazil; [2]Denpasa - Dendê do Pará S/A, Brazil; [3]Fundação*

Centro Universitário Estadual da Zona Oeste, Brazil; [4]Federal Rural University of Rio de Janeiro, Brazil

Composition of Caiaué oil produced in Brazil Caiaué (Elaeis oleifera Kunth) is a native plant from South and Central Americas. Its fruits are similar to those of oil palm (Elaeis guinensis Jacq.), although its oil has a different composition. Caiaué was initially explored as a genetic resource in oil palm breeding programs, since these two species can be crossed producing fertile hybrid decendents. Recently, some Brazilian companies started extracting caiaué oil expecting to obtain a more nutritionally attractive composition as compared to palm oil. Therefore, in this study two samples of caiaué oil from 2018 harvest were assessed regarding their fatty acid composition, that were analyzed by GC-FID; tocochromanols and carotenoids, by HPLC-DAD simultaneous method; and acidity, refractive index and density, according AOCS methods. The caiaué oil fatty acid composition showed lower contents of saturated fatty acids (C16:0 26.4-26.7%) than both palm oil and palm olein, and higher values of unsaturated fatty acids, with C18:1 (54.7-55.7%) and C18:2 (15.5-17.0%) the major ones. The main tocochromanol was γ-tocotrienol, which represents 80-82% of the total tocochromanol values (979-1328 μg/g). The main carotenoids were the pro-vitamin A all-trans-α-carotene and all-trans-β-carotene, which together account for 64-69% of total carotenoids values (2145-2330 μg/g). Acidity was 1.1-1.3% (as oleic acid), refractive index (40°C) was 1.4615-1.4618, and relative density (40°C/20°C) was 0.898-0.899. The obtained results indicate that caiaué oil analyzed in this study showed lower tendency for stearin formation during storage as compared to other similar oils, as well as a good composition from the nutritional point of view.

22. The sterol profile of high oleic palm oil produced in Brazil. Rosemar Antoniassi[1], Allan E. Wilhelm[1], Adelia F. Faria-Machado[1], Andréa M. Guedes*[1], and Paôla A. da Costa[2], *[1]Embrapa Food Technology, Brazil; [2]Federal Rural University of Rio de Janeiro, Brazil*

The sterol profile of High Oleic Palm Oil produced in Brazil Interspecific palm hybrids obtained from the cross breeding between African oil palm (Elaeis guineensis Jacq.) and American palm, caiaué (Elaeis oleifera Kunth), present an oil called "High Oleic Palm Oil" due to its higher content of oleic acid, as well as higher content of bioactive compounds such as carotenoids and tocotrienols, when compared to palm oil. The Brazilian production is around 7,000 tons, which can reach over 40,000 tons of oil per year due to the increase in cultivated area. The fatty acid composition and sterol profiles are the main identity characteristics presented in the Codex Alimentarius Standards for fats and oils and there are no data for sterol profile for this oil produced in Brazil. The unsaponifiable matter and the sterol fraction were obtained according to AOCS Official Method. The gas chromatography analysis was performed using an Agilent 7890 fitted with a methyl silicone (25 m X 0.32 mm X 0.17 μm) column, and oven temperatures from 260 to 290°C at 3°C/min. Injector and detector were kept at 300°C. The ranges obtained for sterol profile were: Cholesterol (1.7 – 2.7%), Campesterol (17.4 – 20.4%), Stigmasterol (11.2 – 13.6%), Beta-Sitosterol (62.4 – 67%), and Delta-5-avenasterol (ND – 1.8%). The total sterols ranged from 521 to 785 mg/kg. The High Oleic Palm Oil produced in Brazil showed narrower ranges compared to that of palm oil and palm olein from Codex Alimentarius Standard; and Cholesterol content was lower for the Brazilian Oil. These results are useful for the High Oleic Palm Oil Standard proposed to Codex Alimentarius.

23. Evaluación del rendimiento Industrial del aceite de oliva extra virgen en el distrito de Tacna. Claudia C. Salaverry*[1], and Gloria J. Pascual[2], *[1]Universidad Nacional Agraria La Molina, Perú; [2]Universidad Nacional Agraria La Molina, Peru*

Se evaluó en la presente investigación el rendimiento industrial, calidad fisicoquímica y sensorial del aceite de oliva extra virgen de cuatro variedades de olivo (Olea europaea L.) del distrito de Tacna, Perú. El diseño fue del tipo cuasi-experimental con variable variedad como independiente y co-variable el tiempo de cosecha. Las variedades fueron sevillana, frantoio, coratina y moraiolo las cuales se cosecharon con un índice de madurez entre 2 a 3,5; humedad entre 52 a 56 %; acidez del fruto cercano al 0,1 % y un contenido graso entre 24 a 28%. Por extracción con el sistema Abencor la variedad frantoio reportó un rendimiento industrial de 14,1 %; sevillana 16%; coratina 13,58% y moraiolo 12,14%. Se hallaron diferencias significativas en la acidez de las variedades pero todas calificaron como extra virgen con valores debajo de 0,8%. El tiempo de cosecha influyó en el incremento del valor K270. El índice de peróxidos resulto cerca de 20 meq/kg al final de la cosecha. Se percibieron los descriptores afrutado, amargo, picante y verde. Con algunas notas de almendra e higuera.

24. Evaluación sensorial de margarinas preparadas con aceites de coco y palma. Luz Bertoia[1], Jorge Wagner[2], and Andrés L. Márquez*[3], *[1]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos (LIFTA), Universidad Nacional de Quilmes, Argentina; [2]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos, Dept. de Ciencia y Tecnología, Universidad Nacional de Quilmes, Argentina; [3]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos (LIFTA), Universidad Nacional de Quilmes; CONICET, Argentina*

El objetivo fue evaluar la aceptabilidad sensorial de emulsiones símil margarina preparadas con grasas vegetales sin tratamientos de hidrogenación o interesterificación. Las emulsiones fueron preparadas con 20% p/p de fase acuosa dispersa (conteniendo sal y saborizante) y una fase lipídica con polirricinoleato de poliglicerol (PGPR) como emulsionante y cúrcuma como colorante. El ensayo hedónico fue realizado con dos muestras seleccionadas: una margarina con aceites de coco y palma en partes iguales y 1% p/p de PGPR (M1); y otra margarina con aceite de coco como única materia grasa y 2% p/p de PGPR (M2). Un total de 60 evaluadores fueron encuestados, incluyendo personas con dieta vegana o vegetariana. Ambas margarinas recibieron valoraciones favorables en todos los parámetros evaluados, obteniendo promedios superiores a 3,5 en una escala de 5 puntos. El análisis estadístico indicó que la emulsión M1 obtuvo mejores calificaciones en apariencia/color, aroma y untabilidad; y la emulsión M2 recibió mejores calificaciones en textura en la boca, aceptabilidad del sabor y valoración general. La muestra M2 también obtuvo mejores apreciaciones en cuanto a gusto salado y sabor a manteca, probablemente debido a una más rápida fusión de la grasa en la boca. No obstante, cuando los evaluadores fueron consultados sobre la preferencia por una u otra margarina, no se observó una tendencia a favor de una muestra en particular. Por lo tanto, si bien en el balance general la muestra M2 pareció ser el mejor sistema, se puede concluir que ambas margarinas fueron aceptables según la evaluación de consumidores potenciales.

24. Sensory evaluation of margarines prepared with coconut and palm oils. Luz Bertoia[1], Jorge Wagner[2], and Andrés L. Márquez*[3], *[1]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos (LIFTA), Universidad Nacional de Quilmes, Argentina; [2]Laboratorio de Investigación en Funcionalidad y Tecnología de Alimentos, Dept. de Ciencia y Tecnología,*

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The objective was to evaluate the sensory acceptability of margarine-like emulsions prepared with vegetable fats without hydrogenation or interesterification treatments. Emulsions were prepared with 20% w/w dispersed aqueous phase (containing salt and flavoring) and a lipid phase with polyglycerol polyricinoleate (PGPR) as emulsifier and curcuma as colorant. The hedonic test was performed with two selected samples: a margarine with coconut and palm oils at equal parts and 1% w/w PGPR (M1); and another margarine with coconut oil as the only fat matter and 2% w/w PGPR (M2). A number of 60 evaluators were surveyed, including people with vegan or vegetarian diet. Both margarines received favorable qualifications in every evaluated parameter, obtaining mean values that were higher than 3.5 within a 5 points scale. The statistical analysis indicated that emulsion M1 obtained better ratings regarding appearance/color, aroma, and spreadability; and emulsion M2 received better ratings regarding texture in the mouth, taste acceptability, and general qualification. Sample M2 also obtained better appreciations of salty taste and butter-like flavor, probably because of a more rapid fusion of fat in the mouth. However, when the evaluators were asked about the preference for one or the other margarine, no tendency was observed in favor of a particular sample. Therefore, although an overall balance indicates that sample M2 seemed to be the best system, it can be concluded that both margarines were acceptable according to the evaluation of potential consumers.

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26. Characterization of Colombian crude glycerol as a potential substrate for lactic acid production by fermentation. Laura J. Castellanos Suárez, Luis J. López Giraldo, and Viviana Sánchez Torres, Universidad Industrial de Santander, Colombia

In recent years, the use of biofuels has been widely developed and its production has grown exponentially. Crude glycerol – CG- is the main by-product obtained from the production of biodiesel from vegetable oils, in quantities of 10-40% by weight. In 2017 the production of biodiesel in Colombia was 459,807 tons and it is estimated that by 2020 its production will be six times higher than the market demand. As a consequence, CG has a great potential to be used as a raw material in other processes due to its low commercial price. However, one of the main challenges is the variability of its composition, since it depends on biodiesel production parameters. Despite the importance of CG chemical composition, few references have been found on its characterization. On the other hand, our previous work showed that crude glycerol used as a substrate in lactic acid fermentation allows higher productivities than glycerol USP. Therefore, it is vital to understand the effect of CG components on reactions catalyzed by microorganisms. In this sense, this research explains the effect of CG components on the volumetric productivity of lactic acid. To fulfill this scope, the following stages are being developed: a) chemical characterization and identification of CG compounds of three samples, b) design of experiment of mixtures to evaluate the productivity of Lactobacillus sp. in a fermentation medium.