2009 Annual Meeting Abstracts

MONDAY

MORNING

H&N 1: Measuring Coronary Heart Disease Risk: Value of Existing and Emerging Surrogate Biomarkers
Chair(s): S. Zaripheh, Dairy Management Inc., USA

Developing a Framework for the Qualification of Surrogate Endpoints for Chronic Disease Risk. K. Ellwood, Office of Nutrition, Labeling and Dietary Supplements, FDA/CFSAN, College Park, MD, USA

Surrogate endpoints of chronic disease risk are risk biomarkers that serve as a substitute for clinical endpoints (e.g., coronary heart disease). Surrogate endpoints predict clinical benefit and can be modified by various factors such as diet, drugs and lifestyle. The lack of surrogate endpoints requires that the actual clinical endpoint be measured in response to an intervention, such as diet change. Validated modifiable risk biomarkers for chronic disease risk are very limited. The specific goal is to develop a framework for validating modifiable risk factors (biomarkers) for chronic diseases such as cancer, heart disease, diabetes and others that can be the subject of a health claim or qualified health claim.

Heart Disease Risk Factors 2009. E.J. Schaefer , Tufts University, Boston, MA USA

Coronary heart disease or CHD remains a leading cause of death. Established CHD risk factors include age, hypertension, diabetes, smoking elevated total cholesterol and LDL cholesterol, and decreased HDL cholesterol. Treating hypertension, hypercholesterolemia, and smoking have been shown to reduce cHD risk. Emerging risk factors that can be run in most laboratories include elevated levels of apoB, nonHDL cholesterol, C reactive protein, lipoprotein(a), uric acid' fibrinogen, and lipoprotein associated phospholipase A2, as well as decreased levels of adiponectin. . Lipoprotein subspecies are run in specialized laboratories. CHD patients often have increased small dense LDL and decreased large HDL particles as assessed by gradient gels or vertical rotor ultracentrifugation or increased LDL particle number as assessed by NMR. Assays becoming available include tests for small dense LDL cholesterol, remnant lipoprotein cholesterol, and Lp(a) cholesterol. Such tests allow for greater precision in diagnosing lipoprotein abnormalities and optimizing profiles in CHD patients.

Apolipoproteins versus Cholesterol as Markers of the Risk of Vascular Disease and the Adequacy of LDL Lowering Therapy. A.D. Sniderman, K. Williams, Mike Rosenbloom Laboratory for Cardiovascular Research, McGill University, Montreal, Quebec, Canada

Vascular disease is the commonest cause of death worldwide and LDL lowering is the most potent therapy to reduce the risk of vascular disease. This talk will present the evidence that apoB and apoA-I are more accurate markers of the risk of vascular disease than their cholesterol counterparts- TC/LDL C/ non-HDL C and HDL C. It will focus particularly on why apoB is a more accurate marker of the adequacy of LDL lowering than LDL C or non-HDL C. Analyses will be presented on the population advantages of basing therapy on apoB rather than any of the atherogenic cholesterol markers. The data demonstrate that using apoB rather than LDL C or non-HDL C will substantially increase the absolute benefit from LDL lowering therapy, an advantage that is clearest in the groups at moderate and high risk of vascular events.

Lipoprotein Particles in Estimating Cardiovascular Risk: Rationale, Strengths, Limitations. K. Musunuru, Massachusetts General Hospital and Broad Institute of MIT and Harvard, Boston, MA, USA

Although associations between conventional plasma lipids--low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides--and cardiovascular disease are well established, there is epidemiological evidence suggesting that subfractions of lipoprotein particles may be more informative for cardiovascular risk. Methodologies for measuring lipoprotein subfractions, including a novel ion mobility technique,

will be reviewed. As an example of the use of lipoprotein particles to estimate cardiovascular risk, we have used the ion mobility technique to determine lipoprotein profiles in more than 4,500 participants in the prospective Malmo Diet and Cancer Study Cardiovascular Cohort. We find that specific particle subfractions are highly associated with cardiovascular disease in this cohort; it remains to be determined whether these subfractions improve risk prediction beyond conventional plasma lipids. Using genetic analyses, we find that specific genes are associated with specific lipoprotein particles, highlighting that there are multiple biological pathways underlying lipid and lipoprotein metabolism.

Plasma Biomarkers of Inflammation and Endothelial Dysfunction: Identification and Predictive Value. Samia Mora[1,2], [1]Brigham and Women's Hospital, USA, [2]Harvard Medical School, USA

Measurement of the inflammatory biomarker high sensitivity C-reaction protein (hsCRP) has been proposed for assessment of risk for cardiovascular disease (CVD). Current data indicate that hsCRP levels are independently associated with risk of CVD, add predictive power to current coronary risk scores for intermediate risk individuals; and are associated with clinical outcomes in high risk individuals treated with statin therapy. Recent data from the JUPITER trial will be highlighted. JUPITER demonstrated that hsCRP can be used to target high risk patients with normal LDL cholesterol but without known vascular disease or diabetes who would benefit from statin use. Among patients who are treated with statin therapy, achieving low levels of hsCRP may be a clinically relevant therapeutic goal along with achieving low levels of LDL cholesterol. Lifestyle and dietary effects on hsCRP will also be discussed. In summary, guidelines for practitioners could include testing for elevated levels of hsCRP for asymptomatic men $\geq$ 50 years, and women $\geq$ 60 years, when LDL-C levels are not elevated in whom the decision to treat with statin therapy is not otherwise clear.

Thrombogenic/Hemostatic Factors: Strengths, Limitations, Predictive Value. R.P. Tracy, University of Vermont, Burlington, VT, USA

Atherosclerotic coronary heart disease may be a chronic progressive process or may be associated with acute cardiovascular disease (CVD) events such as unstable angina, myocardial infarction or sudden cardiac death. Acute events are often associated with plaque rupture or erosion and commonly have a thrombotic component, especially in younger people. This has led to exploring coagulation and fibrinolysis factors as possible risk factors (RFs). Ambient levels of coagulation factors that are associated with known CVD RFs such as obesity, and/or are acute phase reactants (APRs; e.g., fibrinogen, factor VIII) generally are moderately strong RFs for CVD events. However, levels of factors that are not APRs (e.g., factor VII) are much weaker RFs. The same is true for ambient levels of fibrinolysis factors, the best studied of which is PAI-1. Polymorphisms in coagulation and fibrinolysis genes, even when they are strong RFs for venous thrombosis (e.g., factor V Leiden), are weak RFs for CVD events. Biomarkers of coagulation and fibrinolysis activity, such as the fibrin degradation product D-dimer, are also moderately strong RFs for CVD events, possibly because they reflect the degree of activation of these systems occurring due to the extent of atherosclerotic disease. There is evidence that in younger people, especially women, coagulation may play a greater role in CVD events, while in older people these RFs may predict imminent events in particular.

Panel Discussion.

AFTERNOON

H&N 2: Optimizing Vitamin D Intake: Current Recommendations, Future Trends, and Disease Risk
Chair(s): C. Cifelli, Dairy Management Inc., USA

Vitamin D: Are We Getting Enough?. R.P. Heaney, Creighton University, Omaha, NE, USA

Vitamin D, in addition to promoting intestinal calcium absorption, plays a key role in gene expression in the immune system and in many epithelial tissues. Health benefits include decreased cancer risk, improved blood pressure control,

improved immune function and infection resistance, reduced aches and pains, reduced falling, and greater bone strength. These functions are optimized only at serum 25(OH)D3 levels above 32 ng/mL, and may require 40-60 ng/mL. Roughly 65-85% of the U.S. population has levels below 32 ng/mL. Current intake recommendations are inadequate either to reach or to sustain 32 ng/mL. Serum 25(OH)D rises by about 1 ng/mL for every additional daily intake of 100 IU D3. It can be shown that, bringing 97% of the U.S. population to or above 32 ng/mL, would require an additional input on the order of 2600-2700 IU/d. The safe upper intake is 10,000 IU/d.

Vitamin D and Bone Health. S.I. Barr, University of British Columbia, Vancouver, BC, Canada

The role of vitamin D in preventing childhood rickets has been known for many years, but more recently, new data have emerged highlighting its importance for bone health across the lifespan. This presentation will begin with an overview of traditional and new roles of vitamin D in calcium absorption, bone mineralization, and fracture prevention. Next, evidence will be presented to demonstrate that: 1) vitamin D decreases the risk of falling in older individuals (another mechanism for fracture prevention); 2) vitamin D acts in conjunction with calcium to enhance bone density and decrease fracture risk in adults; 3) 400 IU vitamin D isn't enough for fracture prevention, ~800 IU appears to be helpful, and we don't know whether even larger amounts would be more helpful; 4) vitamin D is associated with bone density in children and young adults; 5) rickets remains a concern; and 6) maternal vitamin D status in utero may 'program' a child's future bone health.

Vitamin D: Role in Insulin Resistance. D. Teegarden, Purdue University, West Lafayette, IN, USA

The growing incidence of prediabetes and clinical Type 2 diabetes, in part characterized by insulin resistance, is a critical health problem with consequent devastating personal and health care costs. Vitamin D status, assessed by serum 25 hydroxyvitamin D (25OHD) levels, is inversely associated with the risk of diabetes in epidemiological studies. In addition, several clinical intervention studies also support that vitamin D, or its active metabolite 1,25-dihydroxyvitamin D ($1,25(OH)_2$ D), improves insulin sensitivity, even in subjects with glucose metabolism parameters classified within normal ranges. The mechanisms proposed which may underlie this effect include potential relationships with improvements in lean mass, regulation of insulin release, altered insulin receptor expression and specific effects on insulin action. These actions may be mediated by systemic or local production of $1,25(OH)_2$ D or by suppression of parathyroid hormone (PTH), which may function to negatively impact insulin sensitivity. Thus, substantial evidence supports a relationship between vitamin D status and insulin sensitivity, however, the underlying mechanisms require further exploration.

The Relationship Between Vitamin D and Cancer. G.G. Schwartz, Wake Forest University Health Sciences, Winston-Salem, NC, USA

Mortality rates for several (non-skin) cancers, such as cancer of the prostate, breast, and colon, are known to increase with increasing distance from the equator. This finding has suggested that vitamin D, which is synthesized cutaneously in response to ultraviolet light and can also be obtained from dietary sources, may protect against the risk of several non-skin cancers. The hormonal form of vitamin D, 1,25(OH)2D, is known to promote the differentiation and to inhibit the proliferation, invasion and metastasis of many cells, including those of the breast, prostate and colon. Many of these cells can themselves hydroxylate the major circulating form of vitamin D, 25-Hydroxyvitamin D, which is formed in the liver, into the active vitamin D hormone. The recognition that 1,25(OH)2D is an autocrine hormone has stimulated great interest in the possible use of vitamin D compounds to prevent and to treat cancer. This presentation summarizes recent findings on the roles of vitamin D in the natural history of cancer including recent recommendations to increase vitamin D supplementation.

Panel Discussion.

TUESDAY

AFTERNOON

H&N 3: N-3 Fatty Acids: Existing and Emerging Benefits

Chair(s): E. Bailey-Hall, Martek Biosciences, USA; and A. Ryan, Martek Biosciences, USA

Docosahexanoic Acid for Alzheimer's Disease: Design and Initiation of a Clinical Trial. J. Quinn[1], E. Bailey-Hall[2], E. Nelson[2], K. Yurko-Mauro[2], [1]Oregon Health and Sciences University, Portland, OR, USA, [2]Martek Biosciences, Baltimore, MD, USA

Background: Epidemiologic studies show a reduced risk of Alzheimer's disease (AD) in subjects who consume higher amounts of the omega 3 fatty acid, docosahexanoic acid (DHA). Animal studies demonstrate a reduction of AD pathology in animals which are fed DHA. Hypothesis: DHA supplementation will slow the rate of clinical decline in patients with mild to moderate AD. Methods: A multi-center NIH-funded, double blind placebo controlled trial comparing DHA at a dose of 2 grams per day vs placebo has been initiated at 51 medical centers in the US. The primary outcome measures are rate of cognitive and global clinical decline. Secondary outcome measures include rate of brain tissue loss (from MRI scans) and degree of change in spinal fluid markers of AD.Results: A total of 402 subjects with AD and average daily DHA intake less than 200 mg/d have been enrolled. Demographic data, disease severity data, and baseline plasma DHA levels will be presented. Clinical activity will be completed in May 2009 and results are anticipated by July 2009.Conclusions: DHA is a rational intervention for slowing the rate of clinical decline in AD. An appropriate study population has been recruited despite limitations on dietary intake at baseline and the availability of the study drug outside of the experimental setting.

Liver Synthesis of Docosahexaenoic Acid (DHA) in Relation to Brain Requirements. S.I. Rapoport, M. Igarashi, F. Gao, National Institute on Aging, NIA, USA

DHA is critical to brain and heart integrity. It can be obtained from dietary fish sources or by liver synthesis from its shorter chain n-3 PUFA precursor, α-linolenic acid (α-LNA). Knowing DHA liver synthesis and brain consumption rates could help to assess DHA daily nutritional requirements. In awake rats, brain DHA consumption was determined by infusing unesterified [1-14C]DHA IV for 5 min, measuring tracer incorporated in brain phospholipids, and correcting for integrated plasma specific activity (input function). Liver synthesis of DHA was determined by measuring [14C]DHA in liver after 5 min of IV [1-14C]α-LNA infusion, or measuring esterified DHA and eicosapentaenoic and docosapentaenoic acid plasma concentrations during 2 h of IV [13C]α-LNA infusion. In both studies, liver DHA synthesis from α-LNA exceeded brain DHA consumption rates 10-30 fold, thus could support brain consumption. Liver synthesis was upregulated when DHA was withdrawn from the diet, and further upregulated when α-LNA was withdrawn. Human brain DHA consumption rates have been measured with positron emission tomography (PET), but human liver DHA synthesis rates remain to be determined. Refs: Umhau, J Lip Res (Dec 2008); Igarashi, J Lip Res 48, 152 (2007); Demar, Jr., J Neurochem 94, 1063 (2005); Gao, J Lip Res (Dec, 2008); Rapoport, Prostagl Leukot Essent Fatty Acids 77, 251 (2007).

Anti-inflammatory Effects of Fish Oils and Individual n-3 PUFA. Darshan S. Kelley[1,2], Yuriko Adkins[1,2], Divya Denduluri[1,2], [1]WHNRC, ARS, USDA, Davis, CA, USA, [2]University of California, Davis, CA, USA

Chronic inflammation is a major factor in the development of a number of human inflammatory diseases including diabetes and cardiovascular disease. Diets rich in saturated, trans and n-6 PUFA promote inflammation while those rich in n-3 PUFA reduce it. Evidence supporting the anti-inflammatory effects of n-3 PUFA came from results showing inverse association between serum or cellular n-3 PUFA and inflammatory marker concentrations, reduction in the severity of symptoms for inflammatory diseases, serum concentrations of inflammatory markers and in ex vivo inflammatory leukocyte functions (chemotaxis, phagocytosis, inflammatory cytokine and eicosanoid production) with n-3 PUFA supplementation. Most human intervention studies have used a mixture of EPA and DHA while others used oils enriched in individual n-3 PUFA. All n-3 PUFA tested (18:3 n-3, 18:4 n-3, 20:5 n-3, and 22:6 n-3) demonstrated anti-inflammatory effects, but their efficacies varied. The discrepancies arose from the genotype, anti-oxidant, and inflammatory status of the study participants, amount and duration of the n-3 PUFA intake, specific fatty acid composition of the supplement and that of the basal diet, and inflammatory makers tested and the sensitivity of the

assay system used. We will review the results from select published reports.

The Effects of Algal-DHA on Cardiovascular Risk Factors. A.S. Ryan, E. Bailey-Hall, E.B. Nelson, Martek Biosciences Corporation, Columbia, MD, USA

The cardiovascular benefits of fish-derived long-chain polyunsaturated fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are well established. Less is known about the specific effects of DHA and EPA. Data from 16 clinical trials evaluated the effects of algal-DHA on blood lipids. Studies considered subjects with normal and elevated triglyceride (TG) levels including those with hypertriglyceridemia treated with statins. Results indicated that at doses of 1-2 grams/day, algal-DHA significantly lowered TG levels (up to 26%) either administered alone or in combination with statins. Reduction in TG levels was greater in hypertriglyceridemic than in normal subjects. Algal-DHA modestly increased HDL-C and LDL-C levels. Increased LDL-C level was associated with a shift of lipoprotein particle size toward larger, less atherogenic sub-fractions. An ethyl ester of DHA (900 mg/g) from microalgae (DHA-EE) has been developed by Martek. A study of Wistar rats fed a hyperlipidemic diet evaluated the effects of DHA-EE on levels of TG and cholesterol. Effects of DHA-EE were compared with those produced by Lovaza (EPA+DHA) and a control (corn oil). DHA-EE and Lovaza produced comparable reductions in TG levels. DHA-EE but not Lovaza showed a significant reduction of cholesterol level vs. control.

DHA as a Treatment Option for Alzheimer Disease. F.M. LaFerla, Institute for Brain Aging and Dementia, University of California, Irvine, USA

The underlying cause of sporadic Alzheimer disease (AD) is unknown, but a number of environmental and genetic factors are likely to be involved. One environmental factor that is increasingly being recognized as contributing to brain aging is diet, which has evolved markedly over modern history. Here we show that dietary supplementation with docosahexaenoic acid (DHA), an n-3 polyunsaturated fatty acid, in the 3xTg-AD mouse model of AD reduced the intraneuronal accumulation of both amyloid-β (Aβ) and tau. In contrast, combining DHA with n-6 fatty acids, either arachidonic acid or docosapentaenoic acid (DPAn-6), diminished the efficacy of DHA over a 12 month period. Here we report the novel finding that the mechanism accounting for the reduction in soluble Aß was attributable to a decrease in steady-state levels of presenilin 1, and not to altered processing of the amyloid precursor protein by either the α- or β-secretase. Furthermore, the presence of DPAn-6 in the diet reduced levels of early-stage phospho-tau epitopes, which correlated with a reduction in phosphorylated c-Jun N-terminal kinase, a putative tau kinase. Collectively, these results suggest that DHA and DPAn-6 supplementations could be a beneficial natural therapy for AD.

Omega-3 Fatty Acids for the Developing Infant. S.E. Carlson[1], J. Colombo[2], K. Fitzgerald Gustafson[1], [1]University of Kansas Medical Center, Kansas City, KS, USA, [2]University of Kansas, Lawrence, KS, USA

After the recognition in 1982 that infants fed formulas had lower circulating levels of docosahexaenoic acid (DHA) and arachidonic acid (ARA) than those fed human milk, many studies were conducted to understand the role of these fatty acids in infant development. Most studies focused on brain development, in particular measurement of visual acuity and attention, because together DHA and ARA account for ~50% of the total fatty acids in brain. DHA has received more attention than ARA, because higher brain DHA but not ARA was associated with milk compared to formula feeding, and early work linked low brain DHA to several abnormal behaviors including visual acuity and attention. Interventions have been conducted in utero and after term and preterm birth. These intervals are of interest because DHA normally increases most rapidly in brain between the 22nd week of gestation and 2 years of age. Increasingly, researchers are designing studies with the statistical power to follow experimental cohorts beyond infancy, because early attention has implications for preschool cognitive and language performance. Developmental outcomes of interest in relation to DHA now include other systems such as the autonomic nervous system and immune system. The presentation will include published examples that support the importance of each type of study and that suggest that we have much yet to learn about DHA and development.

Analysis of n-3 Fatty Acids in Nipple Aspirate Fluid (NAF): A Biomarker of n-3 Fatty Acid Status in the Breast. J.G. Erensen[1], B. Cartmel[1], L. Grosso[1], L. Arterburn[2], E. Bailey Hall[2], S.T. Mayne[1], [1]Yale University School of

Public Health, New Haven, CT, USA, [2]Martek Biosciences, Columbia, MD, USA

To determine the feasibility of using nipple aspirate fluid (NAF) as a biomarker of fatty acid status in the breast, a cohort of 95 healthy women aged 25-50 years were interviewed to collect blood, NAF, dietary intake data, and demographic information. Correlation coefficients were determined for docosahexaenoic acid (DHA) and total n-3 fatty acids in red blood cell membranes (RBC), plasma phospholipids, and NAF samples, along with self-reported dietary intake measured by food frequency questionnaire (FFQ). NAF samples were successfully obtained from 72 women (76% of enrolled), and 27 (38% of NAF samples) contained sufficient lipid content for biochemical analysis by gas chromatography (GC). DHA and total n-3 fatty acids in RBC membranes were significantly correlated with their respective measures in NAF. Self-reported DHA intake was marginally correlated with NAF DHA. The results indicate that NAF collection for n-3 fatty acid analysis is feasible in healthy women, and that NAF is significantly correlated with blood measures of DHA and total n-3 fatty acid status.

Docosahexaenoic Acid and Lactation. Craig Jensen, Department of Pediatrics, Baylor College of Medicine, Houston, TX, USA

Docosahexaenoic acid (DHA) is an important component of membrane phospholipids in the retina and brain and accumulates rapidly in these tissues during early infancy. DHA is present in human milk, but the amount varies considerably and is largely dependent on maternal diet. This presentation reviews data addressing the impact of different DHA intakes by lactating women on infant and maternal outcomes to determine if available data are sufficient to estimate optimal breast milk DHA content and estimate dietary reference intakes (DRIs) for DHA by breastfeeding mothers. Results of published observational studies and interventional trials assessing the impact of maternal DHA intake (or breast milk DHA content) on infant visual function, neurodevelopment, and immunologic status were reviewed. Studies related to the potential impact of DHA intake on depression or cognitive function of lactating women also were reviewed. Although only a limited number of studies are available in the current medical literature, and study results have not been consistent, better infant neurodevelopment and/or visual function have been reported with higher vs. lower levels of breast milk DHA. The effect of DHA intake on the incidence or severity of depression in lactating women is not clear. Increasing breast milk DHA content above that typically found in the U.S., by increasing maternal DHA intake, may confer neurodevelopmental benefits to the recipient breast-fed infant. However, current data are insufficient to permit determination of specific DRIs during this period.

WEDNESDAY

MORNING

H&N 4: Fatty Acids in Health Promotion: Recent Developments

Chair(s): R.R. Watson, University of Arizona, USA

Effects of Dietary Fatty Acids on Human Microbes: Role in Health. E. Farnworth, D. Sène, C.P. Champagne, Agriculture and Agri-Food Canada, Canada

The human gastrointestinal tract (GIT) is inhabited by a large number and variety of bacteria. Some of the bacteria are beneficial to the host, some are not. Intestinal bacteria aid in digestion of foods, produce vitamins, produce bacteriocins that kill other bacteria, communicate with the immune system, and cause disease and infection through the production of toxins and other metabolites. Good health depends on a proper balance between the beneficial and non-beneficial bacteria. The lipid requirements for bacteria are not well defined. The growth of different bacterial strains (including pathogens) can be stimulated or suppressed in vitro by the same fatty acid (FA) depending on its structure and concentration. The bacteria that reside in the GIT utilize ingested dietary lipid as free FAs hydrolysed from dietary triglycerides. It has been speculated that changing dietary fat will change the intestinal bacterial population, and this will in turn impact on the development of certain diseases and metabolic disorders. Since much of the FAs are absorbed in the small intestine, this is where free FAs probably exert most of their effects of the GIT microbiota. Bacterial enzyme activity, and the generation of secondary bile acids by intestinal bacteria have been proposed as possible causes of colon and rectal cancer as a result of dietary fat intake. Clinical data to support these hypotheses is

lacking. The microbial population in obese humans changes when they lose weight. Animal studies indicate that intestinal bacteria can influence the absorption, the storage, and utilization of dietary fat, which may in part contribute to obesity. Polyunsaturated FAs, as free FAs , have been shown to suppress growth of probiotic bacteria in vitro and to alter the ability of bacteria to adhere to the intestinal mucus. Short chain FAs generated during fermentation of carbohydrates by intestinal bacteria have been shown to have many effects on metabolism that have long term health consequences.Good clinical data to show if, and how, dietary fat can change the GIT bacterial population and its function have yet to be published. As our understanding of the impact of diet on this important component of metabolism and health increases, the role of dietary fat on human health, through its effect on the GIT microbiota, will become clearer.

Free Fatty Acids: Role in Insulin Resistance/Type 2 Diabetes and Cardiovascular Disease. G. Boden, L.H. Carnell , Temple University School of Medicine, Philadelphia, PA, USA

Obesity is tightly linked with elevated plasma FFA levels, insulin resistance, low grade inflammation, endoplasmic reticulum (ER) stress and a greatly increased risk for ASVD (heart attacks, strokes and peripheral vascular disease). There are many causes for this association some of which have recently been elucidated. Among those, FFA have emerged as a major link between obesity and insulin resistance and type 2 diabetes. Most obese people have elevated plasma FFA levels and FFAs cause insulin resistance in skeletal muscle (by decreasing insulin stimulated glucose uptake) and in the liver (by decreasing insulin inhibition of glycogenolysis). The mechanisms involved include intracellular accumulation of diacylglycerol, activation of several serine/threonine kinases (including PKC, JNK, IKK, p38 MAPK) and decreased tyrosine phosphorylation of IRS 1/2 which causes inhibition of insulin signaling.

FFA also activate the proinflammatory and proatherogenic NFkB pathway resulting in synthesis and release of inflammatory cytokines (including TNF-a, IL-1b, IL-6, MCP-1) and strongly activate the tissue factor pathway of blood coagulation and, via hyperinsulinemia, activate several matrix metalloproteinases (such as MMP2, MMP9, MT1-MMP) known to be involved in development of acute coronary events. In addition, FFA and high fat diets have recently been found to produce ER stress which also (via activation of JNK) can produce insulin resistance and inflammation.

In conclusion, considerable progress has been made during the past ten years in our understanding of the mechanisms responsible for the 2-5 fold increase in ASVD risk in obese people.

Fatty Acids in Corn Oil: Role in Heart Disease Prevention. Marie-Pierre St-Onge, New York Obesity Research Center, St. Luke's/Roosevelt Hospital, New York, NY, USA

Low-fat diets have long been advocated for CVD risk reduction. However, emerging evidence points towards more liberal total fat intakes granted that the overall fat profile of the diet is low in saturated and trans fats. There is thus an emphasis on reducing dietary saturated (SFA) and trans fatty acids while increasing the intake of unsaturated fatty acids. Both high monounsaturated fatty acid (MUFA) and high polyunsaturated fatty acid (PUFA) diets can lead to reductions in TC and LDL-C concentrations without adversely affecting HDL-C and TG concentrations but there remains some controversy, however, with respect to which unsaturated fats, PUFA or MUFA, can produce the most beneficial lipid profile for CVD risk reduction. Corn oil, which is high in PUFA and also contains an appreciable amount of MUFA, is well positioned for creating beneficial effects for heart disease risk reduction. In fact, when compared to higher saturated and trans fat diets, diets rich in corn oil have been shown to produce beneficial effects on the lipid profile. These effects on cardiovascular disease risk profile may be due to the unique combination of PUFA and MUFA found in corn oil but may also be the result of corn oil's other phytochemical components, such as phytosterols. This paper will review the evidence leading to the conclusion that corn oil consumption may play a role in heart disease prevention.

Leptin Regulation of Cardiac Remodeling Due to Obesity. Sherma Zibadi[1,2], Felina Cordova [2], Douglas Larson[1], Ronald Watson [1,2], [1]Sarver Heart Center, School of Medicine, University of Arizona, Tucson, AZ, USA, [2]College of Public Health, University of Arizona, Tucson, AZ, USA

Obesity contributes to the onset and/or development of heart diseases. Obesity-induced remodeling of cardiac extracellular matrix (ECM) leads to myocardial fibrosis and stiffness, and ultimately diastolic dysfunction. Leptin, an adipokine over-produced in obesity, is emerging as a novel mechanistic link between obesity and heart diseases. Despite the known essential role of leptin in hepatic and renal fibrosis, effect of leptin on cardiac ECM remodeling remains unclear. To provide proof that leptin is one of the key mediators of profibrogenic responses in the heart, we administrated leptin to 5 month-old C57BL/6 and leptin-deficient ob/ob mice at 0.1 μg/g, sc, 3 times/week for 8 wks. Leptin-deficient ob/ob mice demonstrated eccentric hypertrophy, associated with significant increase of pro-MMP-2 and -8, TIMP-1 and -3 mRNA level, all implicated in collagen degradation, marked increase in pro-MMP-2 activity, and a reduction in cardiac collagen, compared to C57BL/6 control. Upon treatment with leptin, ob/ob mice displayed diastolic dysfunction and partial reversal of eccentric hypertrophy, coincided with significant increase in pro-Collagen Iα1 and IIIα1, suppression of pro-MMP-8, TIMP-1 and -3 gene expressions, and increase in myocardial collagen, compared to ob/ob controls. These data indicate the profibrotic effects of leptin in the heart, through increased collagen synthesis/degradation rate.

H&N 4.1: General Health and Nutrition I
Chair(s): H. Durham, Louisiana State University, USA; and J.A. Nettleton, ScienceVoice Consulting, USA

Impact of Different Plant Oils on Lipid Related Parameter and Metabolic Control of Patients with Type 2 Diabetes. K.-H. Wagner[1], E. Plasser[1], E. Muellner[1], H. Brath[2], [1]University of Vienna, Vienna, Austria, [2]Health Center South, Vienna, Austria

The number of people with Type 2 Diabetes (DM2) is continously increasing. The link between food fat and DM2 is not well established.To study the effects of different PUFA-rich plant oils (a pure single oil-SO and a mixed oil-MO) a large intervention trial was conducted. 92 participants (34 insulin-dependent and 58 non-insulin-dependent) consumed a standardized teaspoon of the respective oil three times per day for 10 weeks (approx. 9 g/d). Blood samples were taken before intervention-T0, after 4 wk (T1) and 10 wk (T2) of intervention, and 8 wk after the end of intervention-T3). The following parameters were analyzed: triglycerides (TG), total cholesterol (TC), LDL-C, HDL-C, blood glucose (BG), adiponectin (Acrp30) and insulin. Fatty acid profile and various antioxidants were assessed to check compliance.After 10 wk of intervention TG could be decreased and Acrp30 at the same time increased. Total-C and LDL-C levels did not change significantly. Neither BG nor Hb1c changed for the total groups, however in a subgroup with initially high BG it decreased significantly. An easy and practical intervention of type 2 diabetics with only few tea spoons of plant oils daily showed increasing Acrp30 concentrations and a positive influence on TG and BG metabolism in a large study cohort.

Single-Cell Oils as a Source of Omega-3 Fatty Acids: Latest Developments. R.E. Armenta, C.J. Barrow, Ocean Nutrition Canada Ltd., Dartmouth, Nova Scotia, Canada

Omega-3 fatty acids, namely docosahexaenoic acid and eicosapentaenoic acid, have been linked to several beneficial health effects (i.e. mitigation effects of hypertension, stroke, diabetes, osteoporosis, depression, schizophrenia, asthma, macular degeneration, rheumatoid arthritis, etc). The main source of omega-3 fatty acids is fish oil; lately however, fish oil market prices have increased significantly. This has prompted a significant amount of research work on the use of single-cell oils as a source of omega-3 fatty acids. Some of the microbes reported to produce edible oil that contains omega-3 fatty acids are from the genus *Mortierella, Schizochytrium, Thraustochytrium* and *Ulkenia*. An advantage of a single cell oil is that it usually contains a significant amount of natural antioxidants (i.e. carotenoids and tocopherols), which can protect omega-3 fatty acids from oxidation, hence making this oil less prone to oxidation than oils derived from plants and marine animals. Production yields of single cell oils and of omega-3 fatty acids vary with the microbe used, and with the fermentative growing conditions and extractive procedures employed to recover the oil. This paper presents an overview of recent advances, reported within the last five years, in the production of single cell oils rich in omega-3 fatty acids.

A New Paradigm for Saturated Fats. E.C. Westman, Duke University Medical Center, Durham, NC, USA

For several decades, saturated fat has been considered the most deleterious of dietary fats, linked, in particular, to

increased risk of heart disease. The thinking in this field (or paradigm) states that total fat, and particularly saturated fat, increases total cholesterol and LDL cholesterol. An increase in serum cholesterol results in an increase in risk of heart disease. This traditional paradigm has driven government bodies and not- for-profit organizations to urge the public to avoid eating saturated fat, using tools such as healthful food claims and limits in dietary saturated fat intake. Recent research regarding diets which contain high amounts of saturated fat yet lower serum cholesterol have called into question the traditional view that dietary saturated fat is always unhealthy. This presentation will review recent and earlier dietary fat research and discuss whether our current thinking on saturated fats needs to be modified.

Formation Kinetics of Cyclic Fatty Acid Monomers of Linolenic Acid: Effects of *cis*/*trans* Isomers. Amelie Desmarais[1], Jean-Louis Sebedio[2], Joseph Arul[1], Paul Angers[1], [1]Department of Food Sciences and Nutrition, and Nutraceutical and Functional Foods Institute (INAF), Universite Laval, Quebec, Quebec, Canada, [2]Unité de Nutrition Humaine, Institut National de la Recherche Agronomique, Clermont-Ferrand, France

Cyclic fatty acid monomers (CFAM) are formed at low levels in edible fats and oils during thermal processing operations such as frying or refining, and inevitably, constitute part of the human diet. However, the kinetics involved in their formation remains to be determined. The objective of the present study was to evaluate the effects of cis/trans isomers on cyclization reactions involved in the degradation of alpha-linolenic acid (Ln). Geometrical isomers of Ln were chemically obtained from all-cis Ln by nitric acid treatment which promoted the formation of mono- and di-trans isomers. These were separated by families using silver nitrate-silica gel chromatography, and identified by gas chromatography, based on literature data. All-cis Ln and isomers were heat treated at 275°C in hexadecane for periods of 2, 4, 8, 12, 16 and 24 hours, and CFAM formation was monitored by GC. The results show that mono-trans isomers at C9 and C15 form CFAM at an accelerated rate, compared to the corresponding cis isomers, resulting in the formation of higher levels of CFAM over shorter time period. This work suggests that the use of polyunsaturated vegetable oils over long period for thermal processing of food may result in the formation of CFAM, in particular if mono trans isomers are present in the oil.

Omega-3 Fatty Acid Profiling and Dietary Forensics. K. Stark, University of Waterloo, Waterloo, ON, Canada

Omega-3 fatty acids in blood correlate to dietary omega-3 fatty acid intakes. Both intakes and blood levels of omega-3 fatty acids have been associated with reduced risk of chronic diseases. Dietary intake assessment is time consuming for both the assessed and assessor and there can be various limitations in the resultant data. Micronized blood sampling and rapid analytical techniques may be less invasive and generate more accurate and precise data. Unfortunately, blood measurements of omega-3 fatty acids are complicated by type of blood fraction such as plasma, erythrocyte and whole blood, and the fraction of fatty acid containing lipid such as phospholipids, triacylglycerols and cholesteryl esters. The manner or reporting omega-3 fatty acid status also varies with a tendency for results to be presented qualitatively as the relative percentage of total fatty acids and a variety of sums and ratios that include and exclude various polyunsaturates in blood. Presently, individual omega-3 fatty acids in human blood were determined and compared to dietary fatty acid intake assessments and the impact of acute fish oil supplementation and washout was examined. Individual fatty acid responses and calculated omega-3 fatty acid biomarkers were examined using both conventional analytical techniques, but also with techniques having potential high throughput capacity that would enable large scale and routine clinical fatty acid profiling.

AFTERNOON
H&N 5: General Health and Nutrition II
Chair(s): K. Stark, University of Waterloo, Canada; and J. Whittinghill, Solae LLC, USA

Cell Proliferation and Migration are Influenced by Sphingolipids in Caco2 and Caco2/HT29 Co-culture Cells. S. Li, B. Jones, J. Friel, M. Suh, University of Manitoba, Winnipeg, Manitoba, Canada

Human milk is enriched with sphingolipids, especially sphingomyelin. How these molecules protect against gastrointestinal disease during infancy is unknown. We investigated the influence of sphingolipids on proliferation,migration and barrier function of intestinal cells in vitro. Sphingomyelin (SM), gangliosides (GG) and N-

acetylneuraminic acid (NANA) were applied to Caco2-BBE and a co-culture Caco2-BBE-HT29-MTX.Cell viability, proliferation, and migration were assessed by live dead assay, MTT assay and an in vitro wound assay. Tight junctions were assessed by measuring transepithelial electrical resistance (TEER). SM, GG and NANA treatments increased cell viability. Cell proliferation was enhanced in a dose dependant manner in GG and NANA treated co-culture cells. SM also enhanced cell proliferation but not in a dose dependent manner. In injured Caco2-BBE cells, percentage wound closure was increased with SM, GG and NANA. TEER was increased with SM and GG. These novel data demonstrate that sphingolipids may play an important role in intestinal epithelial wound healing by modulating cell proliferation,cell migration and tight junctions. Sphingolipid enriched human milk may protect against intestinal infection and/or can improve recovery of damaged enterocytes, that often occur in premature infants.

A Novel Method to Quantify Fatty Acids in Fingertip Prick Blood. A.H. Metherel, K.D. Stark, University of Waterloo, Waterloo, Ontario, Canada

Fingertip prick blood collection on chromatography paper can be utilized for rapid qualitative fatty acid determinations. Presently, quantitative fatty acid determinations from blood collected on chromatography paper is examined. A die was used to cut an area of 195mm^2 from 3mm thick chromatography paper. The die-cut paper weighed 8.86 ± 0.23mg (n=32). Whole blood collected from a single participant was applied to the paper strips to saturation in quadruplicate. Saturated paper was allowed to dry briefly, die-cut, and weighed (23.68 ± 0.85mg) and blood masses determined (14.82 ± 0.85mg). The saturated papers were used in a direct transesterification procedure (n=4) with 17:0 methyl ester used as an internal standard (301 ± 12.1 μg/100mg of blood). Conventional extraction (Folch) and transesterification of venous whole blood (241 ± 7.6) and direct transesterification (279 ± 2.8) was completed for comparison, indicating increased fatty acid extraction with the direct approach. Various internal standards were also examined with fatty acid ethyl esters and methyl esters producing similar results. However, results differed for quantitative estimates using long-chain (17:0 and 19:0) as compared with very long-chain (23:0 and 22:3n-3) standards. Fingertip blood fatty acid quantitation requires further examination.

Influence of Dietary Gangliosides on Prostate Cancer Biomarkers. J. Miklavcic, M.M. Hitt, V.C. Mazurak, M.T. Clandinin, University of Alberta, Edmonton, AB, Canada

Prostate cancer (PCa) is the second leading cause of cancer-related death in North American men. Many men are able to live long lives with non-invasive disease; however, aggressive metastatic cancer has a poor prognosis. The study objectives were to assess the effect of dietary ganglioside (GG) on cell growth and cell surface levels of GD3 and 9-O-acetyl GD3. Healthy prostate cells (RWPE-1), and metastatic PCa cells of brain (DU-145) and bone (PC-3) were cultured in growth medium supplemented with 10 μg/mL of mixed GG for 48 hours and compared to an unsupplemented control group. Cell counts were estimated using trypan blue exclusion (n=8). Cell surface antigens were stained with monoclonal antibodies and ELISA was performed to compare absorbance between treatment and control groups (n=3). Growth was 21% lower ($p<0.05$) in GG supplemented PC-3 cells, but GG had no effect on growth of either RWPE-1 or DU-145 cells. Cell surface GD3 expression was 34% higher ($p<0.05$), 90% higher ($p<0.04$), and 35% lower ($p<0.01$) in RWPE-1, DU-145, and PC-3 treatment groups, respectively. 9-O-acetyl GD3 was not detected in any cell line. The apoptotic effect of GD3 can be nullified by its conversion to 9-O-acetyl GD3. Prostate cells appear to lack acetylation machinery. Therefore, dietary GG may be beneficial in preventing growth or increasing death or PCa cells.

Combined Effect of Fish Oil and Taurine on Insulin Resistance of Diabetic/Obesity Mice. Nana Mikami, Masashi Hosokawa, Kazuo Miyashita, Hokkaido University, Hakodate, Hokkaido, Japan

To prevent and improve metabolic syndrome, it has been focusing on functional compounds from marine products, because they have unique structures and properties. Fish oil rich in docosahexaenoic acid, eicosapentaenoic acid, and taurine have been reported to possess the effects of improving insulin resistance through glucose and lipid metabolism. However, there is a little report about combined effects of these compounds. In this study, we evaluated the combined effects of fish oil and taurine on obesity and diabetes.Five-week old KK-A^y mice were fed the control diet (CON) based on AIN-93G containing 14% soy bean oil for 4 weeks. Experimental groups were fed the diet replaced 7% soy bean oil with 7% fish oil (FO), casein with 2% or 4% taurine (Tau) and their combinations. The weights of white

adipose tissue (WAT) were significantly lowered in mice fed FO 7%, FO 7% + Tau 2% and FO 7% + Tau 4% groups than that of CON group. Moreover, the suppressive effect on WAT weight gain was stronger in FO 7% + Tau 4% group than FO 7% group. In addition, the levels of blood glucose and insulin were also decreased in mice fed FO 7% + Tau 4% group compared with CON group. These results showed the combination of fish oil and taurine improves insulin resistance strongly compared to single administrations of fish oil or taurine in KK-A^y mice.

Comparison of n-3 Fatty Acid Status via Blood Biomarker and Dietary Intake in Elderly, Middle-age, and Young Adult Populations. A.C. Patterson, R.C. Hogg, J.A. Fratesi, K.D. Stark, The Laboratory of Nutritional and Nutraceutical Research, Department of Kinesiology, University of Waterloo, Waterloo, Ontario, Canada

Objective: Blood status of n-3 highly unsaturated fatty acids (n-3 HUFA) may indicate chronic disease risk associated with aging. Dietary intake and blood levels of n-3 HUFA of Canadian adults across age groups are examined.Methods: Elderly retirement home residents (n=15, 87.1±4.8 yrs of age), middle-aged adults (n=30, 42.4±4.8 yrs) and university students (n=17, 22.2±2.0 yrs) were examined. Finger-tip-prick blood fatty acids were determined by gas chromatography and dietary intake was determined by 3-day food records.Results: Elderly participants had the highest n-3 HUFA% in total HUFA (28.7±5.2%) followed by university students (25.0±5.6%) and middle-aged adults (22.7±3.6%). For the sum of eicosapentaenoic (EPA, 20:5n-3) + docosahexaenoic acid (DHA, 22:6n-3), university students had the highest relative percent (2.85±0.85% of total fatty acids) followed by elderly (2.70±0.14%) and middle-aged adults (2.44±0.62%). The elderly adults had lower blood levels of arachidonic acid (ARA, 20:4n-6). The daily dietary intakes of EPA+DHA were: 505±723 mg (0.18±0.26% energy) by students, 311±508 mg (0.12±0.20% energy) by elderly, and 263±333 mg (0.11±0.12% energy) by middle-aged adults.Conclusion: Strategies to increase dietary intakes of n-3 HUFA by Canadians are required particularly in middle-aged adults.

Inhibitory Effects of Carotenoids on Degranulation of Mast Cells via Antigen-induced Aggregation of FcεRI. Shota Sakai[1], Tatsuya Sugawara[1], Kiminori Matsubara[2], Takashi Hirata[1], [1]Kyoto University, Kyoto, Japan, [2]Hiroshima University, Hiroshima, Japan

Morbidity of type I allergic disease such as pollinosis and food allergy has increased in recent years. Inflammation is induced by chemical mediators secreted from mast cells in type I allergy. Carotenoids have been demonstrated to possess anti-oxidative and anti-inflammatory effects. However, there is no paper reporting effects of carotenoids on degranulation of mast cells. We investigated effects of carotenoids on degranulation of rat basophilic leukemia (RBL-2H3) cells, as a model of mast cells. Fucoxanthin, astaxanthin, zeaxanthin and β-carotene significantly inhibited the antigen-induced release of β-hexosaminidase which is an index of mast cells degranulation. Degranulation of mast cells is triggered by antigen-induced translocation of high-affinity IgE receptor (FcεRI) to lipid rafts followed by aggregation of FcεRI. The carotenoids inhibited the translocation of FcεRI to lipid rafts, the aggregation of FcεRI and the following intracellular signal transduction. These results indicate that carotenoids have an inhibitory effect on mast cell degranulation via suppression of the most upstream of FcεRI-mediated degranulating signals. It is assumed that carotenoids may modulate the function of lipid rafts.

Determination of de novo Synthesis of Plasma Non-esterified Fatty Acids by Deuterium Incorporation in Diabetic and Non-diabetic Subjects. M.S. Wilke, M.A. French, Y.K. Goh, E.A. Ryan, M.T. Clandinin, University of Alberta, Edmonton, Alberta, Canada

Saturated fatty acids (FAs) may play a role in insulin resistance, however plasma non-esterified FA (NEFA) composition is rarely measured. De novo lipogenesis produces saturated FAs but contribution to NEFAs is not known. Objective: To estimate synthesis of NEFAs when varying fat intake in diabetes. It was hypothesized that de novo FAs, mostly saturated, are higher in plasma NEFAs in diabetes subjects after a lower fat (LF) diet versus higher fat (HF). Methods: Seven subjects with type 2 diabetes and 7 matched non-diabetic controls consumed diets differing in fat energy (LF<25%, HF>35%). Fasting NEFA composition and synthesis was estimated. Results: Palmitate, oleate and linoleate were major NEFAs. No diet effect on concentration was observed. Lipogenesis contributed FAs to the NEFA pool at 0-9%, mostly as palmitate. HF intake suppressed lipogenesis by 31% in controls and 50% in diabetes subjects, with significant decreases in palmitate, oleate and stearate synthesis rates. Some relationships were found between NEFA synthesis and concentration. Conclusion: De novo FAs in NEFAs were estimated for the first time, as mostly

palmitate. Higher fat intake suppressed lipogenesis. In some subjects, palmitate synthesis may affect NEFA composition, but the origin of lipogenesis requires investigation.

Health and Nutrition Posters

Chair(s): C.J. Lammi-Keefe, Louisiana State University, USA

Investigate the Magnitude of Differences in Total Metabolizable Protein among Barley Varieties.
Kenton Hart, Peiqiang Yu, University of Saskatchewan, SK, Canada

The objective of this experiment was to determine the magnitude of difference in total metabolizable protein (MP) supply of five feed type barley cultivars in comparison to Canada?s most widely grown malting cultivar AC Metcalfe. Six, two row cultivars of spring sown barley, included AC Metcalfe CDC Cowboy, CDC Dolly, CDC Helgason, CDC Trey and McLeod were grown in the research field of University of Saskatchewan, Saskatoon, SK, Canada for three consecutive years commencing in 2003.The quantitative predictions were made in terms of: 1) Rumen synthesized microbial protein truly absorbed in the small intestine (AMCP); 2) Rumen undegraded feed protein truly absorbed in the small intestine (ARUP); 3) Endogenous protein in the digestive tract (AECP); 4) Total metabolizable protein supply in the small intestine (MP),The results showed that barley variety differed ($P<0.05$) in AMCP ranging from 33.9 to 40.3 g/kg DM andAECP, but had no difference ($P>0.05$) in ARUP with average of 47.5 g/kg DM. Total metabolizable protein ranged ($P<0.05$) from 85.4 to 92.3 g/kg DM. In conclusion, barley variety affected total predicted MP supply.

Intestinal Absorption of Dietary Sphingolipids in Rats.
T. Sugawara[1], T. Tsuduki[2], S. Yano[1], K. Aida[3], I. Ikeda[2], T. Hirata[1], [1]Kyoto University, Kyoto, Japan, [2]Tohoku University, Sendai, Japan, [3]Nippon Flour Mills Co. Ltd., Atsugi, Japan

Sphingolipids are ubiquitous in all eukaryotic organisms and have attracted attention as physiologically function lipids. Recently, various physiological functions of dietary sphingolipids, such as preventing colon cancer and improving the skin barrier function, have been demonstrated. Sphingolipid used as foodstuff is commonly glucosylceramide from plant sources, which is composed of sphingoid bases distinctive from those of mammals. In higher plants, the structure of the sphingoid bases is more complicated than in mammals, because the sphingoid bases can be desaturated at the C8-position by a delta-8-sphingolipid desaturase. However, the fate of dietary sphingolipids of plant origin is still not understood. This study investigates the absorption of glucosylceramide originated from maize in the rat intestine by a lipid absorption assay of lymph from the thoracic duct. The free form of sphingoid bases hydrolyzed from maize glucosylceramide (4,8-sphingadienine) were found in lymph, though cumulative recovery of 4,8-sphingadienine was extremely low (<0.1%). The plant type of sphingoid bases could not be detected in ceramide and complex sphingolipids fractions of lymph. These results suggested that dietary glucosylceramide originated from higher plants are hardly absorbed from intestine and reutilized in tissues.

Differences in Plasma Endocannabinoid Concentrations in Pregnant versus Non-pregnant Women.
H.A. Durham[1], J.T. Wood[2], J.S. Williams[2], M.P. Judge[3], A. Makriyannis[2], C.J. Lammi-Keefe[1], [1]AgCenter and College of Agriculture, Louisiana State University, Baton Rouge, LA, USA, [2]Center for Drug Discovery, Northeastern University, Boston, MA, USA, [3]School of Nursing, University of Connecticut, Storrs, CT, USA

Endogenous cannabinoids, endocannabinoids, are lipid messengers and analogs of polyunsaturated fatty acids. The endocannabinoid metabolome is comprised of over a dozen metabolites associated with a variety of functions in central and peripheral physiology and development. We quantified 15 plasma analytes of the endocannabinoid metabolome in pregnant women (n=12) at 20-22 weeks versus non-pregnant women (n=9) using liquid chromotography-mass spectrometry. Ethanolamides were higher in pregnant versus non-pregnant women: palmitoylethanolamine, mean±SD; (3.56 ± 0.94 pg/µl versus 1.98 ± 0.40 pg/µl, $p<0.01$), oleoylethanolamine (3.52 ±

0.69 pg/µl versus 1.37 ± 0.39 pg/µl, p<0.01) and arachidonoylethanolamine (0.43 ± 0.32 pg/µl versus 0.24 ± 0.10 pg/µl, p=0.11). The glycerol, 2-arachidonolglyerol (85.57 ± 45.13 pg/µl versus 9.96 ± 5.80 pg/µl, p<0.01) was significantly higher during pregnancy while 2- oleoyglycerol (269.10 ± 165.36 pg/µl versus 1217.64 ± 466.35 pg/µl, p<0.01) was lower in pregnancy. In conclusion, pregnancy altered specific metabolites in the plasma endocannibinoid system. These results demonstrate the need to further explore the role for these metabolites in maternal health and infant development. Funded in part by: LSU AgCenter, Nestle, Ltd (Switzerland) and USDA Initiative for Future Agriculture and Food Systems.

Synthetic Approaches to Kilogram Quantities of Transvaccenic Acid.
Jianheng Shen, Yunhua Jia, Martin Reaney, University of Saskatchewan, Saskatoon, SK, Canada

CLA is a natural food component found in the lipid fraction of meat, milk and dairy products, and *cis*-9-*trans*-11 CLA is the principal dietary isomeric form of CLA. It is now evident that the major *trans*-fatty acid found in ruminant meat and milk is *trans*-vaccenic acid (TVA, *trans*-11 C18:1) which has been found to protect against chemically-induced mammary cancer in rats. Biosynthetic evidence indicates that TVA is readily converted by the bacterial enzyme Δ^9-desaturase into *cis*-9-*trans*-11-conjugated linoleic acid. Currently there are no stereoisomerically pure forms of TVA available for nutritional studies to determine whether the nature of the health effects ascribed to TVA are due to the fatty acid alone or attributable to metabolic conversion of TVA to CLA. This data are essential to define the health implications of CLA and TVA enriched functional foods and nutraceuticals for the development and application of enhanced human nutrition and health products. In this contribution, we present approaches to stereoselective preparation of both *cis* and *trans*-vaccenic acid.

Antioxidant Capacity and Lipid Characterization of Georgia–grown Underutilized Fruit Crops.
G. Pande, C.C. Akoh, The University of Georgia, Athens, Georgia, USA

Four underutilized Georgia–grown fruit crops namely loquat, mayhaw, fig, and pawpaw were separated into seed, pulp, and peel. Both hydrophilic and lipophilic fractions were prepared and each fraction was analyzed for total polyphenols by Folin Ciocalteau method. Organic acids and phenolic compounds were identified by RP-HPLC. Antioxidant capacity was determined by TEAC and FRAP assays. The leaves and whole fruit were also studied. The seeds and whole fruit fractions of each fruit were also analyzed for fatty acid and tocopherol content. The major organic acids identified in mayhaw and pawpaw were malic and citric acids, in loquat malic acid and in fig malic, citric, and oxalic acids. The hydrophilic fraction of each part showed higher phenolic content and antioxidant capacity with the highest value being in seeds and leaves. High correlation was observed between total polyphenols and TEAC assay results. The predominant phenolic compounds in all the fruits were gallic and ellagic acids and catechin. But ferulic acid, epicatechin, and p-coumaric acid were also found in considerable amount in mayhaw. The seeds and whole fruit fractions of loquat and mayhaw contained 56.5, 62.8, 43.9, and 21.2% C14:0, respectively. Pawpaw seeds and whole fruit and fig fruit contained 49.2, 6.4, and 15.3% C18:2 cis, respectively, as major fatty acid.

The Impact of Including a High Stearidonic Acid Oil on Fatty Acid Intake of U.S. Population.
Chunling Wang[1], Kim Smith[2], Shawna Lemke[1], Barbara Petersen[2], [1]Monsanto Company, St. Louis, MO, USA, [2]Exponent Inc., Washington, DC, USA

Oilseeds with modified fatty acid compositions are being developed to improve the nutritional quality of the diet. One example is high stearidonic acid (18:4n3) soybean oil (SDA SBO), which will provide heart healthy omega 3 fatty acids to consumers. We evaluated the impact of including two varieties of SDA SBO (30% and 20% w/w SDA) in proposed food categories. Recipes used in this assessment were adjusted to ensure that both oil varieties delivered 375 mg SDA per serving of food. Consumption data were derived from the 1999-2002 National Health and Nutrition Examination Survey. Fatty acid components of commercially used oils were derived from the United States Department of Agriculture Nutrient Database. When possible, the total fat content of food was kept constant by replacing existing oil. When there was no oil to replace, SDA SBO was added. Results suggested that the US population will get 2.2 g/day of SDA on average and 4.2 g/day at the 90th percentile by introducing 375 mg SDA per serving of food in the proposed food categories. The inclusion of SDA SBO also resulted in a slight increase in total fat intake due to inclusion of SDA SBO in some foods that currently do not include oil in their recipe. Minor, but not

nutritionally significant, changes in the intakes from other fatty acids were noted by inclusion of either SDA SBO.

Long-chain Saturated Fatty Acids Induce Pro-inflammatory Responses and Impact Endothelial Cell Growth.
G.P. Zaloga[1], T. Pavlina[1], K.A. Harvey[2], C. Walker[2], Z. Xu[2], R.A. Siddiqui[2], [1]Baxter Healthcare, Deerfield, IL, USA, [2]Methodist Research Institute, Indianapolis, IN, USA

Long-chain saturated fatty acids (SFAs) have been linked to an increase in cardiovascular disease complications. However, the effect of SFAs upon acute inflammation is less clear. The objective of this study was to evaluate the acute effects of SFAs upon human arterial endothelial cell (EC) functions. Total growth inhibition of ECs was observed on treatment with arachidic acid (34μM), stearic acid (85μM) and palmitic acid (223μM). Medium-chain length SFAs, including lauric, capric, caprylic and caproic acids, did not significantly affect EC growth (<300μM). Furthermore, a trend in growth enhancement was evident in ECs with butyric acid (above 100μM). Stearic acid supplementation induced EC apoptosis and subsequent necrosis. Palmitic acid induced only a small increase in the percentage of apoptotic and necrotic cells. Stearic acid (>10μM) treatment significantly increased ICAM-1 expression. In contrast, palmitic and myristic acid supplementation increased ICAM-1 expression at 100μM, whereas caprylic acid did not significantly alter ICAM-1 expression. Long-chain SFAs can induce pro-inflammatory responses and significantly impact cell growth and viability of ECs. Our data suggest that the presence of long-chain SFAs in nutritional formulations may have harmful effects on the vascular system.

Contents of Conjugated Linoleic Acid Isomers (CLA) in Dairy Foods and Their Contribution to Daily Intake of CLA in Brazil.
J.C. Nunes, A.G. Torres, Laboratorio de Bioquimica Nutricional e de Alimentos, Departamento de Bioquimica, Instituto de Quimica, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil

The objectives of this study were to determine the contents of total and individual CLA isomers in Brazilian dairy foods (DF) and to assess the contribution of these foods to the daily intake of CLA. The most consumed sources of dairy fat by the Brazilian population (milk, butter and cheese) were analyzed. Analysis of CLA isomers: A) Quantitative by Ag-HPLC; B) Qualitative by GC-MS of DMOX. The daily intake of CLA was estimated based on DF consumption (Brazilian Diet Survey; 2003). The total CLA contents (mg/g fat) in milk, butter and cheese were (mean ±SD), respectively: 6.19±1.34, 5.06±1.32 and 3.9±0.06. The isomers t-7,c-9, c-9,t-11, t-8,c-10, t-11,c-13, c-12,t-14, t-11,t-13 and t-9,t-11 were identified, and the two predominant isomers were (min–max): c-9,t-11 (82–90%) and t-7,c-9 (3.2–5.8%). The estimated daily intake of total CLA in Brazil was 25 mg/day and milk contributed to 80%, butter to 15% and cheese to 4.4% of the daily intake of CLA. CLA intake (mg/day) in Brazil was 32 in the most urbanized areas and 19 in the rural areas, and was 39 for Brazilians with the highest incomes and 14 for those with the lowest incomes. The daily intake of CLA in Brazil was low, compared to European countries, and influenced by the degree of urbanization and family income of the Brazilian population.

Effect of Grazing White Clover Pasture on Milk Fatty Acid Composition of Holstein and Jersey Cows.
X.C. Fretté[1], T. Kristensen[2], J. Eriksen[2], K. Søegaard[2], J. Sørensen[1], L. Wiking[1], J.H. Nielsen[1], [1]Aarhus University - Faculty of Agricultural Sciences, Institute of Food Sciences, Denmark, [2]Aarhus University - Faculty of Agricultural Sciences, Institute of Agroecology and Environment, Denmark

Because of its high saturated fatty acid (FA) content milk fat is considered hypercholesterolemic (Ulbricht and Southgate, 1991). Intake of unsaturated FA (UFA) reduces the plasma cholesterol concentrations (Fernandez and West, 2005). Especially conjugated linoleic acids (CLA) have shown positive effects on cardiovascular diseases (Valeille et al., 2004), prevention of cancer (Ip et al., 1994) and obesity (Park et al., 1997). The aim of our project was to investigate how grazing could enhance the content of these beneficiary FA in milk from Holstein and Jersey cows. For both types of cow races we observed no direct effect of increased grazing in the diet on the short chain FA (SCFA) content in milk, implying that the de novo synthesis of these FA remained unaffected. Regarding the content of CLA c9,t11 there was a strong positive effect on Holstein milk (R2 = 0.88), but almost none on Jersey milk when the percentage of grazing increases in the diet, thus suggesting that the mammary gland 9-desaturase activities of these two cow races react differently to increasing pasture grazing.

Nutritional Evaluation of European Ready Meals.
S. Kanzler, M. Manschein, K.-H. Wagner, Department of Nutritional Sciences, Vienna, Austria

Mainly due to time scarcity more and more consumers are purchasing ready meals. However not many studies have focused on the nutrient composition of these meals, in particular not Europe-wide.In total 34 all-in-one meals from different European regions were prepared according to the instructions and the contents of fat, protein and salt as well as the fatty acid pattern were analysed. The contents of energy and carbohydrates were calculated.Total energy of the tested ready meals ranged from 265 to 945 Kcal/serving. Fat based on total energy varied from 6.1 to 59.0 E%, whereby 17 out of 34 meals contained more than the recommended 30 E%. Regarding the fat quality, saturated fatty acids varied strongly from 1.5 to 22.7 E% and polyunsaturated fatty acids from 1.0 to 14.8 E%. More than the recommended 10 E% of saturated fatty acids were found in 16 out of 34 meals. Salt ranged from 3.4 to 7.7 g/serving. Hence, all meals contained more salt than recommended for one serving (> 1.8 g), some meals even exceeded the recommendation for one day (> 6.0 g).The energy contents of most of the tested ready meals are appropriate for male and female adults. But half of the tested meals contained too much fat (> 30 E%) and too many saturated fatty acids (> 10 E%). The salt contents of all analysed meals exceeded the recommendation, in most cases by even more than 100 %.

Optimization of Tripalmitin Fractionation from Palm Stearin by Response Surface Methodology.
J.H. Lee, J.M. Son, K.T. Lee, Chungnam National University, Department of Food Science and Technology, Republic of Korea

Tripalmitin (PPP) rich fraction was produced from palm stearin by an acetone fractionation, in which response surface methodology (RSM) was employed to optimize its purity (Y_1, %) and yield (Y_2, %) with reaction parameters - temperature (X_1, 25~35°C) and acetone ratio (X_2, 3~9 in weight ratio). The predictive models for PPP purity and yield of fraction were adequate and reproducible due to no significant lack of fit (0.267 and 0.268, respectively), and satisfactory levels of R^2 (0.97 and 0.98, respectively). The probabilities for the regression of purity and yield were significant ($P<0.001$). The purity showed a positive relation with temperature and acetone ratio ($P<0.01$), whereas the yield exhibited negative relation ($P<0.01$). The production of PPP rich fraction with a 22% > PPP yield at 90% > PPP purity was optimized using Modde 5.0. The reaction parameter of temperature of 27.54°C and acetone ratio of 9 was predicted to produce a fraction with 91.51% of purity and 23.8% of yield. To confirm the predicted response, the scale-up of acetone fractionation was re-done under the same condition, and the PPP rich fraction with 92.41% and 23% of purity and yield were observed. Therefore, these results suggested that the RSM model was valid to optimize PPP purity and yield from palm sterain by acetone fractionation.

Determination of Total and Positional Fatty Acid Composition of Selected Infant Formulas.
J.M. Son, J.H. Lee, K.T. Lee, Chungnam National University, Department of Food Science and Technology, Republic of Korea

Infant formula is one of the main sources of nutrient and energy for infants replacing human milk. To analyze the fatty acid composition, infant formulas were purchased from Korea (n=8), Japan (n=1) and U.S.A (n=2). Crude fats were extracted using Folch method, and their fatty acid composition (total and positional) was analyzed using gas chromatography. In total fatty acid composition of infant formulas, oleic (24.4-45.4%), palmitic (7.7-21.8%) and linoleic acids (17.2-22.1%) were the major fatty acids. Infant formula form Korea contained higher level of saturated fatty acid than those from U.S.A and Japan. Monounsaturated fatty acid was found more abundantly in infant formulas from U.S.A and Japan than those from Korea. Omega-3 (1.6-2.5%) and omega-6 (17.7-22.5%) fatty acids were contained in all infant formulas. *Trans* fatty acid (0.3-1%) and conjugated linoleic acid (0.0-0.3%) were indentified in a small amount. In *sn*-2 position, oleic (11.8-51.3%) and palmitic (1.9-38.9%) acids were most abundant fatty acids in the formulas, and among the selected countries, oleic acid was higher in U.S.A, while palmitic acid was more abundant in Korea and Japan.

A Trial to Product of CLA-Enriched Bread.
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Objective. Although conjugated linoleic acid (CLA) exerts numerous health benefits, it occurs exclusively in meat or milk of ruminants at a level far lower than expectable of any effect. CLA has been used as a component of functional foods for various purposes in the U.S. and European countries. In Japan, CLA also is sold as a supplement, but is not allowed to use as a food additive due in part to an uncertainness of heated CLA. In order to develop food use, we tried to produce breads enriched with CLA and examined its stability during storage.Methods. Breads containing graded levels of CLA, 0, 0.5, 1 and 2 g per slice (about 460 g), were prepared , stored at 25oC, 5oC or -18oC and then evaluated organoleptically by panels. Lipids were extracted with C:M (2:1, v/v) and CLA was analyzed by the standardized GLC method.Results. CLA remained quantitatively unchanged in bread. Palatability parameters of 0.5 and 1g CLA enriched-breads were comparable to those of breads without CLA , and the 0.5 g CLA-bread was evaluated tasty. There were also no reductions of the CLA contents during storage at 25oC and 5oC for at least 8 days, and at -18oC for at least 15 days, suggesting protection against oxidative damages . The present study indicated that addition up to 1 g per slice of bread of CLA can reasonably be accepted. The results may provide helpful information regarding the use of CLA in related products.

High Oleic Palm Oil: Healthy and Versatile Oil.

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Palm oil is mainly obtained from the *Elaeis guineensis Jacq.*, is an important natural source of carotenes and tocotrienols and has palmitic/oleic acid radio of 1:1. South America has another type of oil palm named *Elaeis Oleifera,* whose oil has higher levels of unsaturated fatty acids and carotenes than the oil from the *E. guineensis.* Currently there is available an interspecific hybrid from *E. Oleifera* and *E. guineensis,* which produces palm oils that contains the best characteristics of the two species for human nutrition: unsaturation and versatility. Since cardiovascular disease is the first cause of dead in America, and it has been related with dietary risk factors, the food industry is developing products with low content of saturated fatty acids and trans free. Those are obtained by using natural semisolid oils with a balanced fatty acids profile, such as the hybrid palm oil. This oil is source of oleic acid (48-58%), a cardio-healthy fatty acid, and has moderated palmitic acid content, characteristics that make it healthy and versatile for the food industry and the consumers. The objective of this paper is to present fatty acids and triglyceride composition of nineteen oils from hybrid palms planted in three regions of Colombia.

The Effect of Arachidonic Acid on Fatty Liver Induced By CLA in Mice.

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Conjugated linoleic acid (CLA) has anti-obesity, but induces fatty liver in mice. The present study investigated whether arachidonic acid (ARA) prevents fatty liver induced by CLA in mouse. Male mice (8 wks old) were given diets with either no addition of dietary fat, 3% LA, 3% CLA, 3% CLA + 1% ARA, or 3% CLA + 2% ARA for 4 wks. The liver and white adipose tissues in mice were weighed after feeding, and several lipids content in the liver and plasma were measured. Plasma TG concentration was significantly higher in the CLA group than in either CLA + ARA group, while total cholesterol and NEFA concentrations in plasma did not different among the groups. The weight of the perirenal fat in ARA-treated groups decreased similarly as with CLA alone, when compared to control or LA. In contrast, liver weight was significantly higher in the CLA group than in the control or LA groups, and the effects of CLA were attenuated by ARA. TG and total cholesterol were markedly accumulated in the liver with dietary CLA, whereas CLA + ARA groups suppressed CLA-induced lipid accumulation. Liver prostaglandin (PG) E2 was enhanced by combination of CLA and ARA when compared with CLA alone. In conclusion, co-administration of ARA prevented fatty liver induced by CLA in mice, and combination of CLA with ARA maintained anti-obesity as an effect of CLA.

Stabilization of Long Chain ω-3 Polyunsaturated Fatty Acid Esters.

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The long chain ω-3 polyunsaturated fatty acid (EPA and DHA) containing oils are susceptible to oxidation, limiting

their utility. Traditionally, in order to stabilize these oils are fortified with natural and or synthetic antioxidants. Here we report first time a novel natural ingredient, rice bran wax that improves the oxidative stability of polyunsatuated ω-3 oils. The polyunsaturated oils containing rice bran wax exhibited excellent oxidative stability. When the wax esters are dissolved in polyunsaturated oils at low concentrations (~ 0.5%) and cooled, the wax molecules readily solidify into a thin crystalline mesh and entrap large volumes of liquid oil. Such encapsulated solids with large volumes of liquid oil are called organogels. The organogels made with menhaden oil, and rice bran wax (at 1.5%) without any added anti-oxidants, showed oxidative stability comparable to commercial antioxidants (500 ppm of tocopherols and 200ppm TBHQ).

Development of a Clinical Protocol for Ranking Foods/Meals Based on Postprandial Triglyceride Responses.

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The testing and ranking of food products with respect to postprandial blood glucose responses (the Glycemic Index) has become popularized in food formulations and marketing. However, there is extensive evidence that postprandial triglyceride levels, in addition to fasting levels, are positively correlated with an increased risk for atherosclerosis and cardiovascular complications. In our research, a specialized beverage containing fat and carbohydrates was formulated to elicit considerable postprandial elevations in blood glucose as well as triglycerides (the Lipemic Index TM). Testing various food products at identical caloric intakes to that of the standard mixture in healthy subjects provided for calculation of the area-under-the-curve values (total and positive net) for triglycerides relative to the standard and to other products. For example, the testing of a commercial beverage product targeted to diabetics yielded considerable increases in positive net areas-under-the-curve for postprandial triglycerides (Lipemic Index TM) up to five hours despite favourably low blood glucose responses (up to two hours). Our results indicate that the newly developed concept of the Lipemic Index TM should be considered in addition to the Glycemic Index when formulating and testing food products for specific health outcomes.

Fatty Acid Content of Breast Milk from Women with and without Gestational Diabetes Mellitus.

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Long chain polyunsaturated fatty acids are critical to infant growth, vision, and neurological development. We assessed FA content of breast milk of women with (n=5, GDM) and without GDM (n=5, C). Milk samples were collected at 2, 6, 10, and 12 weeks using a breast pump. Milk FA methyl esters were prepared by direct transesterification and separated, identified, and quantitated with HP 5890 GC. Preliminary findings demonstrate a trend for GDM without a prenatal supplement with DHA (PS/DHA) to have lower DHA (22:6n-3, wt %) compared to controls at weeks 2, 6, and 10 postpartum (2 wks: GDM, 0.24; C, 0.31%; 6 wks: 0.14 vs. 0.20%; 10 wks: 0.16 vs. 0.22%). For women taking PS/DHA postpartum, there was no difference between GDM and C. At weeks 6 and 10, PS/DHA GDM had significantly higher DHA compared to GDM without PS/DHA. There were no differences for ARA (20:4n-6; ave, 0.6 to 0.8 wt %). LC-PUFA n-3/n-6 ratio tended to be higher in PS/DHA for GDM and C. We conclude, based on preliminary findings, that women with GDM should be advised to take PS/DHA during both pregnancy and lactation. (Funded in part by National Fisheries Institute and LSU AgCenter).

Effect of Dietary Fish Protein and Oil on Lipid Metabolism in Rats.

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In this study, we evaluated the effects of dietary fish protein and fish oil on the serum and liver lipid contents. The hepatic expressions of genes encoding proteins involved in cholesterol metabolism were also determined. Five-week-old Wistar rats were fed AIN93G diets containing fish protein (FP), fish oil (FO), a combination of fish protein and

fish oil (FPO), and high cholesterol variations of the FP, FO and FPO diets. As parameters of lipid metabolism, the concentrations of total cholesterol (T-Chol) and triacylglycerol (TG) in serum and liver, fecal steroid excretion, and hepatic mRNA expression levels of genes involved in cholesterol metabolism were examined. FP diets decreased the serum levels of T-Chol, low density lipoprotein-cholesterol (LDL-C), and hepatic T-Chol, but increased fecal steroid excretion and hepatic cholesterol 7α-hydroxylase; FO diets decreased the serum and liver levels of TG, but did not affect the serum of T-Chol and LDL-C. In addition, FPO diets decreased the serum level of T-Chol, TG and LDL-C, and showed an additive effect of FP and FO on increased fecal steroid excretion. This study found that FPO diets exerted hypotriglyceridemic and hypocholesterolemic effects that inhibited arteriosclerosis.

α-Linolenic Acid Requirements in Developing Lepidoptera.
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Dietary α-linolenic acid is required for the successful development of most lepidopteran insects, although it is unclear at which developmental stage linolenic acid is limiting, as well as how and where it is metabolized. As many Lepidoptera are agricultural pests, a better understanding of their linolenic acid requirements may aid in the establishment of sustainable control strategies. *Heliothis virescens* and *Heliothis subflexa* larvae were grown on an artificial diet with or without linolenic acid. For both species, the presence of linolenic acid significantly enhanced the rate of eclosion, and for *H. subflexa* pupation rate was also enhanced. Subsequent experiments involve starting larvae on diet without linolenic acid and transferring them to linolenic acid containing diet at various stages in development. Larvae were fed on diet containing [1-^{14}C]-linolenic acid and allowed to develop into adults. Radioactivity was monitored at various developmental stages and was detected in larval skin (as phospholipids) and on the surface of the pupal casing, but not on the body surface or wings of the adults. 2-hydroxylinolenic acid from thyme seed oil was fluorinated, or oxidized and fluorinated to produce 2-fluorolinolenic acid and 2,2-difluorolinolenic acid respectively. These fluorinated fatty acids were fed to larvae and mass spectrometry and ^{19}F NMR will be used to monitor metabolites.

Anti-inflammatory Effects of Marine Carotenoids.
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Carotenoids are a family of natural pigments with at least 700 members. Marine organisms are known to contain many kinds of carotenoids with unique structures. To investigate anti-inflammatory effects of marine carotenoids, we measured gene expression levels of pro-inflammatory cytokines and enzymes in macrophage-like RAW264.7 cells. Alloxanthin, diatoxanthin isolated from sea squirt (*H. roretzi*), and pectenolone isolated from scallop (*P. yessoensis*) markedly suppressed mRNA expression and protein production of IL-1β and IL-6 in cells induced by LPS without cytotoxicity. All of these carotenoids have the acetylene structure in the molecule. The suppressive effects of these carotenoids were remarkable compared to those of β-carotene and zeaxanthin. In addition, alloxanthin, diatoxanthin and pectenolone suppressed the over-expression of COX-2 and nitric iNOS mRNA in RAW264.7 cells induced by LPS. These results suggest that the acetylene structure in carotenoid molecule is important for exerting their anti-inflammatory effects.

E-series Resolvins Lipidomics: Profiling Biosynthesis, Actions, and Metabolic Inactivation of Novel Pro-Resolving Mediators.
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Resolvins, a new family of anti-inflammatory and pro-resolving mediators derived from EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) are of considerable interest, as they provide potential molecular-level explanation for some of the beneficial effects described for essential omega-3 fatty acids. For example, Resolvin E1, the first characterized resolvin molecule, has demonstrated its potent anti-inflammatory and pro-resolving actions in various inflammatory models, such as asthma, inflammatory bowel diseases (IBDs) and periodontal diseases. Here we present lipidomic profiles of E series (EPA-derived) resolvin, namely resolvin E1 (RvE1) and E2 (RvE2), covering their endogenous synthesis, function and metabolic inactivation.1) Endogenous formation and biosynthetic pathway of

RvE1 and RvE2. Originally identified in self-resolving exudates, RvE1 and RvE2 are found in human plasma and leukocyte incubations. From the common precursor of resolvin E series, 18-HEPE, 5-lipoxygenase abundant in neutrophil (PMN) is a key enzyme to produce 5S-hydroperoxy intermediate, which could be directly reduced to RvE2, or further form epoxide intermediate that is enzymatically hydrolysed to produce RvE1.2) Anti-inflammatory and pro-resolving functions. RvE1 and RvE2 are essentially equipotent in the murine peritonitis model, yet their sites of actions are distinct from each other. RvE2 stops PMN infiltration when administrated intraperitonially, and possibly regulates early monocyte/macrophage function. Several in vitro models with differentiated human macrophages confirmed this. RvE2 at a nanomolar dose induces anti-inflammatory cytokine IL-10 generation and activates phagocytosis of opsonized zymosan particles.3) RvE1 Metabolome. RvE1 is inactivated by diverse types of cells and enzymes in the local environment. In order to elucidate the ?RvE1 metabolome?, metabolites of RvE1 were monitored and quantitated by multiple-reaction-monitoring analysis. Different organs and species showed different metabolites profile including 18-oxo, omega-hydroxy, carboxy RvE1 and 10, 11-dihydro-RvE1, suggesting multiple pathways to keep tissue and systemic homeostasis after inflammation and subsequent resolution.

Cyclic Peptides in Edible Flax Oil, Flax Containing Feed, and Animals Consuming Flax Products.
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Cyclolinopeptides occur naturally in flax seed and have the potential bioactivity as immunosuppressants. Quantitative HPLC-DAD analysis of the distribution of cyclolinopeptides in flax seeds and the levels of cyclolinopeptides in different commercial flaxseed products including flaxseed oil was conducted. Flax seeds were processed in the laboratory to produce fractions enriched in mucilage, hulls, oil bodies and whole seed flour. Solid fractions were exhaustively extracted with hexane to recover oil and cyclolinopeptides. Cyclolinopeptides were present in significant concentrations in hull extracts, dehulled seed, expressed oil, but only at low levels in oil body and none in water soluble mucilage fractions. Approximately 0.3 mg/mL of cyclolinopeptides was found in commercial flax oil; cyclolinopeptide A, the most hydrophobic cyclopeptide, was 33 to 69% of the total peptide concentration. Electrospray ionization-time of flight-mass spectrometry(ESI-TOF-MS) afforded detection of very small amounts of cyclolinopeptides in fish and pig fat after flax consumption. While dietary cyclolinopeptides may result in accumulation of small amounts of peptide in body fats it is not certain if sufficient peptides are absorbed from the diet to exert biological activity.

Conjugated Linoleic Acid (CLA) Modulates Hepatic PPAR alpha Phosphorylation in Obese Insulin-resistant Zucker Rats.
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Evidence from our lab has shown that the peroxisome proliferator-activated receptor (PPAR) α ligand, conjugated linoleic acid (CLA), reduces stearoyl coenzymeA desaturase (scd) 1 activity in obese insulin-resistant rats, however, the mechanism was not examined. The effect of CLA isomers on the phosphorylation of PPARα and scd1 protein was investigated in the livers of 7 week old male *fa/fa* and lean Zucker rats fed either a control or a CLA isomer (0.4% wt/wt 9cis, 11trans or 0.4% wt/wt 10trans, 12cis) diet for 8 weeks. Western blotting showed that the *fa/fa* rats fed 10trans, 12cis-CLA isomer had lower amounts of scd1 than the *fa/fa* controls. They also had a higher level of extracellular signal-regulated kinase (ERK) 1/2 and PPARα phosphorylation. Our results indicate that CLA modifies the phosphorylation of PPARα which alters its transcriptional activity. The activation of the ERK1/2 signaling pathway could play a vital role in this process. Our findings illustrate a novel mechanism by which CLA reduces scd1 levels.

Estimated Daily Intake of Fatty Acids and the Impact of Substituting Frying Oil with a Low Saturated Fat and High Oleic Soybean Oil.
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Low saturated fat, high oleic, low linolenic soybean oil (LSHOLLSO) is a new soybean oil developed through

biotechnology. The oil has higher oleic levels, lower saturated fats and lower linolenic acid than conventional soybean oil, making it a suitable replacement for unhealthy partially hydrogenated frying oil. An intake assessment was conducted to evaluate the impact of the oil on dietary intake of fatty acids in the U.S. population. The major sources of data were food intake and nutrient composition from NHANES 1999-2002 and Exponent's proprietary recipes. The assessment assumes that 100% of the hydrogenated soybean oil in selected foods for all eating occasions is replaced with the new soybean oil. The replacement was implemented for several broad food categories including commercial/restaurant fried meat, poultry, fish and egg dishes, fried potato products such as commercial French fries, and potato chips/puffs. The results to be presented are from an evaluation of the daily intake (pre and post substitution) of total fat, total trans-fatty acids and five major fatty acids. Replacement of hydrogenated soybean oil under the proposed food uses is expected to result in lower trans fatty acid intake without affecting total fat intake, which is in-line with dietary recommendations for heart health.

Lipid Metabolism in Pregnant, Lactating and Newborn Rats Fed Cholesterol-Enriched Diets.

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From 8 days before mating until day 14 of lactation, rats were fed a control diet or this diet enriched with 0.9% cholesterol (CHOL). Blood samples were taken on gestation day 13, day of parturation and lactation day 14. Milk was sampled on lactation days 1, 4 and 14, brain and liver tissues on lactation day 14. Cholesterol intake did not significantly influence body and brain weight of the pups. Adult rats and neonates of the CHOL group showed significantly elevated liver weight; at 14 days of age liver weight of the offspring was no longer affected. Adult rats of the CHOL group showed significantly higher triglyceride and cholesterol contents in the liver; these effects were not found in the offspring. Cholesterol content of colostrum was increased in the CHOL group; however, this effect was not observed in milk samples taken on day 14. The milk fatty acid profiles in the CHOL group showed elevated contents of 16:1n-7, 18:1n-7, 18:1n-9 and lower contents of 18:2n-6 and 18:3n-3. During gestation as well as lactation, plasma triglyceride and cholesterol contents were significantly increased in the dams fed the CHOL diet; a similar effect, although less pronounced, was noted in the pups of this group. Brain cholesterol and fatty acid profiles in adult rats and offspring were not substantially affected by dietary treatment.

Milk Fatty Acids. New Findings, New Perspectives.

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In the cow's milk fatty acids(FA), is a primordial core, produce de novo (PTdenovo) from C4:0 to C14:0, C14:1ω5cis, Δ9 . Myristic acid (MA) may represent 52 % of this primordial core, myristoleic (MLA): C14:1ω5cis, 5 to 6%. MA (1.8 % total energy) combined with linolenic acid (0.9%) act on the red blood cell membrane fluidity.Two conjugated FA (CFA) are present in milk fat: rumenic (RA) and C18:2 ω –5cis, –7trans. Ratio may vary in the proportion of 35 depending mainly on feeding. In Switzerland highlands milks, in spring time, the ratio is 15 /1 to 10/1. CFA: 18:2w-5cis, n-7trans, may vary between 2 and 8% of total CLA.RA is synthesized in vivo after Δ9 desaturation of C18:1 ω-7t. Δ9cis desaturation of the CFA C18:2 ω5cis, ω7t, will give C18:3 ω5cis, ω7t, ω9cis known as punicic acid (PA), present in pomegranate oil. This CFA contains the complete site forming a pocket configuration not far from α-linolenic′s (ALA), and similar to the binding pockets found in mediators (resolvins) for the inflammation′s resolution.We found on a model of Priming step, in the inflammation process, that PA had a strong inhibitory effect (F. Driss &al).Clinical studies first results, showed a drop of Lp (a), of oxidized LDLs, when increasing MA from 0.6% to 1.8% of total energy. The primordial core was also increased, as were the CFA: C18:2, ω5cis, ω7t, ALA acid (0.9%), and LA (4.6%).