

Agenda- Annual Meeting NC-1039
N-3 Polyunsaturated Fatty Acid and Human Health and Disease
October 16th and 17th, 2008
University of Nebraska-Lincoln, Lincoln, Nebraska

The Cornhusker, A Marriott Hotel, 333 South 13th, Lincoln, NE

Thursday October 16th

Welcome and Introductions

Members present: Nancy Lewis (Meeting Organizer), Kimberly Heidal, Susan Welch, Audrey Adler, Ken Allen, Jennifer Anderson, K. Shane Broughton (Interim Chair).

Visitors: Concetta DiRusso (UNL).

AES Administrative report and discussion - Gary Cunningham

Suggests expanding the relationship between the extension researchers and the lab scientists.

The group needs to identify a clear direction for growth and based on this direction should try to recruit additional members to expand the breadth and expertise of the group.

EB meeting: Saturday, April 18th 5:00 pm.

CSREES Report and discussion - Susan Welsh

Farm Bill, change CSREES to NIFA, must now have a political appointee for up to 6 years at a time. There will be reorganization: AFRI and how money will now be distributed. Bench research and application is a strong focus. The new 6 directors will design a road map. The NRI announcement has been pushed back, an announcement will be made in November and some integrated subject areas will be functional foods from the bench work area and obesity.

Business Meeting: current membership on the committee

Listserves for group: update email addresses.

Membership and the types of research conducted by individual research.

Focus areas to recruit:

Nutrition education projects: summary of student projects.

Discussion on omega-3 research and frequently asked questions for eXtension COP

Audrey Adler explained the rationale behind creating the eXtension site (a community of practice, NC-1039).

There is a need to recruit outside members that are experts in this field to be involved in this project.

eXtension National vision/priorities - Dan Cotton reviewed eXtension, benefits, logistics for creating our site and possible venues for marketing including sponsors from potential corporate partners.

Friday October 17th

Plans for meeting next year – select a date and place

Election of officers for next year: Chair, Kimberly Heidal; Secretary, Elena Serrano.

Place: Greenville, NC; Wednesday October 7, Thursday October 8, and Friday October 9

Discussed the focus of the eXtension proposal. Expanded the categories of health benefits. Discussed the need for 100 questions for eXtension.

Developed a description of works for eXtension to send out for recruiting individuals to participate in this project.

The website for NIMSS is: nimss.umd.edu

Areas of responsibilities for eXtension proposal:

Chair:

Debrah Palmer

Prevalent health conditions:

Jay Whelan, Kate Claycombe, Nancy Lewis (Subgroup Chair), Shane Broughton, Bruce Watkins, Mary Harris, Ken Allen

Higher education professional training:

Kimberly Heidal, Kathy Kolassa, Susan Carlson

N-3s for health:

Jennifer Anderson, Concetta DiRusso,

Reviewers:

Audrey Adler

Possible sponsors:

Martek

GNC

Shaklee

CA walnut council

Station Reports: October 1st 2007 – September 30th 2008

The Ohio State University

Omega three fatty acids in stress and obesity

Martha Ann Belury, Carol S. Kennedy Professor of Human Nutrition

Omega three fatty acids are bioactive lipids that modulate adipose-derived metabolism of macronutrients and adipokine production. Evidence exists that in chronic stress, omega three levels are predictive for greater markers of inflammation such as interleukin-6 and c-reactive protein (1). These same markers of inflammation play a role in central adiposity and insulin resistance conditions such as metabolic syndrome and type 2 diabetes.

Long-term goal seeks to elucidate the role of omega-3 oils, rich in EPA and DHA, in reducing markers of chronic stress and reducing abdominal adipose mass in human subjects. We have three aims: Aim 1) determine the relationship of abdominal obesity with markers of stress and inflammation in subjects under chronic sustainable of stress. The model they will use is the caregiver model established by Dr. Kiecolt-Glaser. Aim 2) to determine the ability of omega-3 oils to alter abdominal adipose mass and body composition in a double blind, placebo control randomized clinical trial over 36 weeks at doses of 0 g, 4 g or 8 g fish oil as a supplement. The comparative oil will be an oil mix representative of the split of saturated, monounsaturated and polyunsaturated fatty acids as typical in the U.S. diet (NHANES). Aim 3 will evaluate serum measurements of stress that are responsive to omega 3 supplementation. This grant builds upon three existing grants and will be submitted (first version) to the NIH in January 2009. There is a lack of concrete intervention that reduces central obesity and related conditions including metabolic syndrome and type 2 diabetes. We are hopeful that this research will lead to more effective methods for treating central obesity and related disorders that affect morbidity in the US.

Publications:

1. Kiecolt-Glaser JK, Belury MA, Porter K, Beversdorf D, Lemeshow S, Glaser R. Depressive Symptoms, n-6:n-3 Fatty Acids, and Inflammation in Older Adults. *Psychosom Med* 69: 217-224 2007.

Colorado Station Report

Kenneth G.D. Allen (PI) Jennifer Anderson (CoI) Paul Kim (GRA)

A study was designed to determine if dietary fish oil affects the expression and activity of matrix metalloproteinases (MMP), tissue inhibitors of MMP-2 (TIMP-2), and urokinase plasminogen activator (uPA) in synovial fluid from dogs with spontaneously occurring stifle (knee) instability in a single hind limb resulting from acute cranial cruciate ligament (CCL) injury. Two groups of 12 dogs were fed diets from one week prior to surgery on the affected knee to 56 days post-surgery. The fish oil and control diets provided 90 mg and 4.5

mg, respectively, of combined eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)/kg body weight/day. Plasma and synovial fluid, from both surgical and non-surgical knee joints, were obtained at start of the diet (-7), surgery day (0), and 7, 14, 28, and 56 days post-surgery. Plasma total EPA and DHA were significantly increased, and plasma total arachidonic acid (AA) was significantly decreased by the fish oil diet. In synovial fluid from the non-surgical knee, fish oil treatment significantly decreased proMMP-2 expression at days 7 and 14, and proMMP-9 expression at day 56, and uPA activity at 28 days and significantly increased TIMP-2 expression at days 7 and 28. There were no differences in MMP expression or activity, TIMP-2 expression and uPA activity in the surgical joint synovial fluid at any time throughout the study. These results suggest that dietary fish oil may exert beneficial effects on synovial fluid MMP and TIMP-2 equilibrium in the uninjured stifle of dogs with unilateral CCL injury.

Supplementing cultured immortalized human myometrial cells (PHM-41), with 100 μ M docosahexaenoic (DHA) or arachidonic (AA) acids significantly depressed oxytocin-mediated intracellular $[Ca^{2+}]_i$ by 80% relative to equimolar OA controls. Fatty acid analysis of membranes (> 95% phospholipid) showed significant enrichment of membrane DHA or AA. DHA or AA incorporation into myometrial cell membranes decreased oxytocin (OT) receptor numbers and OT oxytocin mediated signaling events. Since dietary means to significantly increase long-chain n-3 PUFA are most likely with fish, fish oils or DHA supplements these results may provide a mechanisms explaining increased gestation duration with long-chain n-3 PUFA supplementation.

Publications:

1. Hansen, R.A., Harris, M.A., Pluhar, G.E., Motta, T., Brevard, S., Ogilvie, G.K., Fettman, M.J. and Allen, K.G.D. Fish oil decreases matrix metalloproteinases in knee synovia of dogs with inflammatory joint disease. *J. Nutr. Biochem.* 19: 101-108, 2008
2. Anderson, J., Auld, G., Allen, K., Harris, M., Davis, A., Gautier, S., Rabon-Stith, K. Educational strategies designed to improve intake of docosahexaenoic acid-rich foods increase gestational length in a WIC population. *J. Am. Dietetic Assoc.*, in press

Theses: None

Abstracts – Invited Presentations:

Anderson, J. Invited Speaker. American Dietetic Association meeting:
American Dietetic Association Annual Meeting, “*Low North American DHA intakes necessitate recommendations during pregnancy,*” Philadelphia, PA 09/30/07

Minnesota Station Report

Douglas Mashek

This past year we have studied omega-3 fatty acids through multiple ongoing projects. First, we have discovered that the ability of omega-3 fatty acids to regulate PPAR- α , a major transcription factor governing hepatic energy metabolism, is largely dependent upon the incorporation and release of these fatty acids from triacylglycerol pools. This work has been submitted for publication. Second, we have tested the central effects of omega-3 fatty acids to modulate food intake through intracerebraventricular infusions of omega-3 fatty acids. Early results indicate that these fatty acids transiently decrease food intake primarily through a robust upregulation of anorexigenic neuropeptides. This manuscript is in preparation. Finally, studies are underway that attempting to identify the intracellular enzymes such as acyl-CoA synthetases and thioesterases responsible for the initial activation and trafficking of omega-3 fatty acids in liver. We anticipate that these various approaches will identify new functions of omega-3 fatty acids and important steps involving their metabolism, which subsequently influence the bioactive properties.

East Carolina University Station Report

Kimberly Heidal

Dietary intake of omega-3 fatty acids in college students was assessed and compared to fast food consumption using two validated food frequency questionnaires and blood markers. This was a pilot test to determine if

college students living in a southern college town are consuming enough dietary omega-3 fatty acids during the off season for seafood/fish.

Outcomes: Dietary intake and blood levels of omega-3 fatty acids are low among college students living in a southern community. Educational measures may be warranted to inform public regarding sources and functions of omega-3 fatty acids.

University of Nebraska Station Report

Nancy Lewis

Omega-3 Learning Modules were developed incorporating key themes from qualitative interviews of dietitians. Modules were based on educational learning theories which connect learner with information in a manner that meets learners' needs. These modules were pilot tested and incorporated into a website. Nebraska Dietitians were invited to view the website and respond to a survey designed to assess responses to the learning modules and to collect frequently asked omega-3 questions. Fifty-three website surveys were completed and data analysis is in process.

IMPACT

Results from this website survey of dietitians will provide information needed to further develop the Community of Practice in Omega-3 fatty acids that meets the needs of health care practitioners.

New Jersey Agricultural Experiment Station Report Rutgers, the State University of New Jersey

Debrah Palmer

During fiscal year 2008, extensive research was done on the structure and requirements of the eXtension web-based, interactive learning environment, and on determining how an eXtension site focused on omega-3 fatty acids could be established, with the NC1039 research group as its core contributors and leaders. The Rutgers team produced a draft of an application to form an eXtension Community of Practise, for presentation and review at the NC 1039 annual meeting. Some preliminary content was also created for this website. The Rutgers team has participated in all NC1039 meetings, providing input for members on accomplishing the group's eXtension objective.

Wyoming Station Report

K. Shane Broughton (PI), Aleksandra Kuzmanov (GRA)

A study to examine if diets enriched in DHA (0.3g/100g diet), EPA (0.3), arachidonic acid (0.3) or mixed EPA and DHA (0.3/3 or 0.15/0.15) influenced ovulation was conducted. With DHA feeding alone, total PGE increased almost 2-fold over control while neither differed from the other treatments. The increased PGE was induced by marked elevation in PGE₃ with unaltered PGE₂ release. PGE₂ remained unchanged in all dietary treatments while PGE₃ increased in response to DHA alone. Total PGF did not differ from control in any dietary treatment though PGF_{2α} in response to ARA was significantly (P<0.05) greater than that seen with DHA. DHA at the 0.3 level, alone or with EPA, resulted in elevated PGF_{3α} when compared to control or to all of the experimental diets. Consumption of the experimental diets did not alter ovulation from control though the EPA only diet yielded a higher ovulation when compared to the D/E .15 diet.

Research to determine if a relationship exists between self-reported dietary intake and plasma n-3 PUFAs and markers related to cardiovascular disease relative to body weight was conducted. Participants were separated into four groups based on gender and BMI (normal and heavy). A positive correlation was found between IL-6 and BMI in heavy males (BMI ≥ 25) (r = .575). Plasma HDL cholesterol levels in heavy males were not different from the normal-weight males, but were lower than all female participants. LDL cholesterol while showing high heterogeneity and being highest in the heavy males did not vary from the other participants. Blood n-3 PUFAs were similar in all women, but were 25% higher in heavy men than all other participants. The differences in the heavy male total plasma n-3 PUFAs were attributable to a higher DHA. However, heavy male DHA levels were not elevated by increased intake as all participants had the same n-3 PUFA and fish intake levels. Normal weight males had 25% lower thyroxine at 6.2 µg/dl than all women who averaged 8.25 µg/dl while the heavy males did not differ from the female participants. Self reported n-3 PUFA intake may predict plasma LDL, triglycerides, HDL and thyroxine in the heavy male population when overall n-3 PUFA ingestion is low.

Report: IRB proposals for a study to examine the effect of n-3 PUFA and vitamin D supplementation in on parameters associated with PCOS have been submitted and recruitment of subjects is underway.

Publications:

One manuscript pending one accepted at: Nutrition Research Journal