

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Childhood Obesity

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
305	Animal Physiological Processes			20%	
701	Nutrient Composition of Food			5%	
702	Requirements and Function of Nutrients and Other Food Components			52%	
704	Nutrition and Hunger in the Population			13%	
723	Hazards to Human Health and Safety			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.6	0.0
Actual Paid	0.0	0.0	0.6	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	46438	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	41382	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

NHAES researchers will:

- Use mass spectrometry data to quantify changes epigenetic changes in chromatin (modification of protein and DNA) of cultured mouse fat cells, and compare these changes in different nutritional states;
- Examine the effects of inflammatory omega-6 fatty acids and non-inflammatory omega-3 fatty acids, from dairy fats, on the development of respiratory allergy in an animal model;
- Compare dairy fats of milk from conventional total mixed ration-fed cows, which are known to be higher in omega-6 fatty acids, with that of pasture-fed organic dairy cows, which are known to be higher in omega-3 fatty acids;
- Develop community-based education programs to improve diet and activity in older adults, which can be refined and evaluated in future projects.

2. Brief description of the target audience

This project is intended to benefit the health of people across New Hampshire and the region, while making the conduct of scientific research more transparent to community partners, stakeholders, and the public.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1857	656	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	5	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Actual
2014	10

Output #2

Output Measure

- Number of university courses in which project results have been incorporated

Year	Actual
2014	4

Output #3

Output Measure

- Number of presentations at regional, national, or international scientific meetings

Year	Actual
2014	8

Output #4

Output Measure

- Number of surveys or other means of gathering information and data from participants

Year	Actual
2014	2

Output #5

Output Measure

- Number of reviewed, bulletin, popular and other publications

Year	Actual
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2014 5

Output #6

Output Measure

- Number of graduate students directly involved in the research.

Year	Actual
2014	3

Output #7

Output Measure

- Number of websites in which project results have been incorporated
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students trained and ready to enter the workforce.
2	Number of undergraduate students involved and trained in engagement research.
3	Evaluate the hypothesis: Milk fat consumption of pasture-fed cows will have a more protective effect against development of allergy development than milk fat cows fed a total mixed ration diet.
4	Enhanced understanding of epigenetic processes in cultured fat cells that may influence fat accumulation
5	Measurable improvement in dietary consumption of whole grains by older adults participating in whole grains foods education training
6	Evaluate whether the increased in prevalence of respiratory allergy and asthma is a correlated with changes in the ratio dietary of omega 6 and omega 3 fatty acids
7	Evaluate whether the fire retardant polybromal biphenylethers (PBDE) disrupt glucose and fatty acid metabolism in a way that may contribute to the growing obesity epidemic in the developed world.

Outcome #1

1. Outcome Measures

Number of graduate students trained and ready to enter the workforce.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population
723	Hazards to Human Health and Safety

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained in engagement research.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population
723	Hazards to Human Health and Safety

Outcome #3

1. Outcome Measures

Evaluate the hypothesis: Milk fat consumption of pasture-fed cows will have a more protective effect against development of allergy development than milk fat cows fed a total mixed ration diet.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2014

0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The trend in respiratory disease has been paralleled by a rise in obesity and change in composition of U.S. diets characteristically high in energy density and imbalanced in omega-6 and omega-3 fatty acids (fa). Arachidonic acid (AA) is an omega-6-fa and is a substrate for prostaglandin E2 (PGE2), which stimulates increased antigen sensitivity. Is the evidence that increased dietary AA correlates with biological markers for allergens, PGE2, antibody IgE and cytokines?

What has been done

Animal studies: Mice were fed diets that varied in ratio of omega-6/omega-3 fa, and then sensitized to chicken ovalbumin. Diet effects on lung macrophage cells (AVM) release of allergy markers, and gene expression were studied. Additional cell culture studies examined the relationship between AA and PGE2.

Results

Animal studies: PGE2 production of AVM of mice fed 6:1 and 15:1 fa diets were more than two times higher than from AVM of mice fed 1:1 diet for six weeks ($p < 0.01$)

Cell culture studies: Release of PGE 2 increased linearly to doses of AA and decreased linearly to omega-3 fa ($p < 0.05$). fatty acid analysis of AVM showed close correspondence between fatty acid content of cells and fatty acid treatments.

Together, these results are consistent with the working hypothesis that the changing composition of omega-6 and omega-3 fatty acids in human diets leads to increased sensitivity to respiratory disease.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components

Outcome #4

1. Outcome Measures

Enhanced understanding of epigenetic processes in cultured fat cells that may influence fat accumulation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Metabolic disease has become a substantial medical and economic burden to the modern society. Though manifested through multiple complications, disturbance in adipose tissue homeostasis lies in the center of the metabolic syndrome. This study examines how development of adipose cells (adipogenesis) is influenced by epigenetic changes, specifically chromatin remodeling.

What has been done

DNA is wrapped around histone proteins in chromatin. Post-translational modifications to histone proteins influence how tightly they bind DNA, and hence what genes are expressed. This project developed very precise quantitative methods to identify chemical modifications in histones in preadipocytes during differentiation and investigated how nutritional factors impact those histone modifications.

Results

Using a systematic approach enabled by quantitative mass spectrometric approach, substantial changes in multiple histone modifications were quantified. The most prominent change takes place on histone H4 Lys16. This study reveals complex changes in methylation on K27/K36, suggesting multiple chromatin subdomains that respond differently during preadipocyte differentiation. In summary, our study, for the first time, describes the transformation of global histone modification landscape during adipocyte differentiation. Key chromatin factors that regulate these changes in histone modifications can serve as molecular targets to modulate adipogenesis and alleviate metabolic syndrome. Results indicate the histone acetyltransferase, MYST1, is a novel chromatin factor in fat cell development. Conceivably, inhibitors that disrupt either its enzymatic activities or its interactions with MLL/SET complex have the potential to treat metabolic syndrome. The high-density, quantitative profiles of histone modifications generated from our study provide useful resources to other researchers, aiming to understand molecular details of adipogenesis and to develop pharmacological agents for the management of metabolic syndrome.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components

Outcome #5

1. Outcome Measures

Measurable improvement in dietary consumption of whole grains by older adults participating in whole grains foods education training

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Eating whole grains is known to reduce some of chronic disease risks in older adults. The average adult in America eats less than one serving of the recommended three serving minimum of whole grains each day. Consumption of whole grains in older adults is particularly low.

of our collaborative research project to investigate barriers to fruit, vegetable and whole grains in older adults, this pilot study investigated the effectiveness of a three-session nutrition education program, entitled *Is It Whole Grain?* to improve older adults knowledge, identification and consumption of whole grains. There is a need to test the efficacy of educational interventions for older adults to increase whole grain consumption.

What has been done

As part of collaborative research project to investigate barriers to fruit, vegetable and whole grains in older adults, a pilot study investigated the effectiveness of a three-session nutrition education program, titled *"Is It Whole Grain?"* to improve older adults knowledge, identification and consumption of whole grains.

Results

Based on the analysis of pre- and post-intervention whole grain questionnaire responses from 157 older adults, aged 60 or older, residing in New Hampshire and Iowa, significant improvements in older adults' knowledge and intake frequency of whole grains were shown. Participants' mean pre- to post- whole grain knowledge scores increased significantly from 15.46 ± 0.38 to 21.96 ± 0.31 ($p < 0.001$). Participants' median frequency of whole grains consumed

increased significantly from eight to ten times a week ($p=0.009$).

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population

Outcome #6

1. Outcome Measures

Evaluate whether the increased in prevalence of respiratory allergy and asthma is a correlated with changes in the ratio dietary of omega 6 and omega 3 fatty acids

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In the US has been a steady increase in prevalence of respiratory allergy and asthma. This is paralleled by a rise in obesity and change in composition of diet. Animal meat protein has become an important dietary source of Arachidonic acid. This omega 6 fa is precursor to a prostoglandin E2 (PGE2), which contributes to stimulating immune cell functions toward development of increased antigen-sensitization and allergy development. Do the ratio of dietary omega6:3 fa influence respiratory allergy and asthma biomarkers?

What has been done

Human studies: The relationship between diet and allergy sensitization, levels of specific-Ig E antibodies to common respiratory allergens were studied in 60 young adult obese and non-obese women, with and without asthma.

Results

Sensitization, sp IgE. antibodies and intake of AA were higher among obese vs. non obese; and between women with asthma than no asthma ($p<0.05$). Dietary AA correlated significantly with

intake of animal protein ($r = .8; p < 0.01$) and with sensitization and antibody levels ($p < 0.01$).

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components

Outcome #7

1. Outcome Measures

Evaluate whether the fire retardant polybromal biphenylethers (PDPE) disrupt glucose and fatty acid metabolism in a way that may contribute to the growing obesity epidemic in the developed world.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

One class of flame retardants ? polybrominated diphenyl ethers, or PBDEs ? associated with childrens' pajamas affect has been shown to be persistent in the environment. Previous work has shown this chemical can be found in the plasma serum of young adults. Research carried out this year was to test whether PDPE disrupts glucose and lipid metabolism in a rat model, consistent with the hypothesis that PDPE acts as 'obesogen'.

or PEPCK, could be the source of this disruption. We've learned that PBDEs suppress liver PEPCK activity by about 40%, reduce the amount of PEPCK protein by about 25% and reduce the activity of a specialized liver metabolic pathway by about

40%.

What has been done

Several experiments were carried out with male rats, whose diet was supplemented either with low levels of PDPE in corn oil (treatment) or corn oil alone (control). The first project looked at whether PDPE disrupted glucose and fatty acid metabolism. The second project examined where PDPE caused changes in the level of a key regulatory enzyme in glucose and fatty acid metabolism: Phosphoenolpyruvate carboxykinase (PEPCK).

Results

1. After 28 days and a 48-hour fast, blood from PBDE-treated rats had significantly higher ketones, but lower glucose and triglycerides, compared to controls. This suggested that livers of PBDE-treated rats were unable to maintain glucose and lipid homeostasis.

2. Both PEPCK protein and glyceroneogenesis rates were reduced by 25 percent and 42 percent respectively in PDPE treated rates compared to controls, suggesting that a suppression in PEPCK protein reduces PEPCK activity, which reduces metabolic flow through glyceroneogenesis.

are consistent with the hypothesis that the environmentally persistent organic chemical PDPE may act to promote weight gain in humans.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Change in Experimental design)

Brief Explanation

Focus of research on the effects of balance of n-6/n-3 fatty acids from conventional versus organic pasture feed dairy on propensity of animals/humans to be sensitized to respiratory allergens was shifted from milk to meat products for two reasons. First, the results of the human study indicated that the consumption of meat products and intake of arachadonic fatty acid (AA) in meat products and not dairy correlated strongly with increased sensitization and elevated specific antibodies to respiratory allergens. Secondly, the wide variation in fat content of dairy products consumed made assessing the effects of milk more complicated, logistically.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The principal means of evaluation of activities in this planned program were acceptance of manuscripts for publication in peer-reviewed journals, invited presentations and participation in professional meetings. In FY 2014, five peer-reviewed papers were

submitted or published from research projects in this planned program FY2014. Five presentations were presented in professional meetings. By these criteria, all research projects in this planned program continue to be effective.

Key Items of Evaluation

The flame retardant polybrominated diphenyl ether (PDPE), is known to persist in the environment and accumulates in the bodies of young adults. Animal studies confirmed that PDPE reduces the level of phosphoenolpyruvate carboxy kinase, a key enzyme in glucose and fat metabolism. These results are consistent with the hypothesis that PDPE may be an obesogen, contributing to the epidemic of obesity in the US.

Sensitization measured as IgE antibodies levels and intake of arachidonic acid, an omega-6 fatty acid (AA) were higher among obese vs. non obese; and between women with asthma than no asthma ($p < 0.05$). Dietary AA correlated significantly with intake of animal protein ($r = .8; p < 0.01$) and with sensitization and antibody levels ($p < 0.01$).