



Beef CLA may protect against diabetes and heart disease

Conjugated linoleic acid (CLA) is a fatty acid naturally found in beef and the aim of this project is two-fold. Firstly it will show whether beef enriched with CLA, as a result of eating grass, has health benefits related to diabetes and heart disease. Secondly, it will use high-throughput genomic technologies to explain how high-CLA beef mediates its protection by identifying the key genes and proteins responsible. Preliminary results show that high-CLA beef has several beneficial effects on genes and proteins regulating glucose metabolism and inflammation thereby explaining how CLA protects against diabetes. Further research is underway to characterise the effect of CLA on key genes related to heart disease. These comprehensive genomic approaches will facilitate the UCD Nutrigenomics team to uncover the potential for high-CLA beef as a functional food. Project code NU018, second update.

Is beef a functional food?

Conjugated linoleic acid (CLA) is a fatty acid naturally found in products of ruminant origin and therefore meat and milk are natural sources of this compound. CLA came to prominence as studies showed that it potentially has a number of health benefits, including protection against certain cancers, heart disease and type II diabetes. There are many different isomers (types) of CLA and this may be responsible for the range of its potential health benefits.

Grass fed animals contains high levels of CLA. Dr Aidan Moloney at Grange Research Centre, Teagasc enhanced CLA levels even further by supplementing the animal's diet with oils (linseed and sunflower, see projects MQ002 and MQ011 on www.relayresearch.ie). Professor Helen Roche's team at University College Dublin looked for potential health benefits of beef high in CLA and their results suggest that it may protect against type II diabetes and inflammatory bowel disease.

CLA may, some day, be responsible for beef being put into the functional food category however, at the moment the jury is still out on this topic. Before, beef can be termed a functional food, much research is required to confirm that beef CLA has protective properties and explain how it mediates these effects.



Grass fed beef is naturally high in CLA. Prof Helen Roche and her team at UCD are using genomic technologies to examine if and how CLA protects against type II diabetes and atherosclerosis (coronary heart disease).

This project is testing the hypothesis that beef high in CLA can protect against type II diabetes and atherosclerosis (coronary heart disease). A cost effective mouse model is being used instead of expensive human trials. Heart disease and diabetes are common diet-related diseases and identifying

functional foods to combat their prevalence has many advantages

The omics explained

In this project, Prof Helen Roche and her team are using state-of-the-art nutrigenomic technologies to examine if CLA-rich beef can combat diabetes and heart disease.

Nutrigenomics studies the interaction between nutrition and the human genome, and two nutrigenomic technologies, are being used, proteomics and transcriptomics. Proteomics studies proteins and their functions and transcriptomics identifies mRNA expression levels.

In summary, the transcriptomics and proteomics will identify which genes and proteins are involved in the protective effect, if any, of CLA.

Mouse feed

Dr Moloney supplied beef containing low and high CLA to the UCD team. The beef was freeze dried and incorporated into mouse feed. Analysis of the diets shows that the high CLA diet had five times more CLA than the low CLA diet.

Mice were fed one of three diets, a control (low CLA) diet, high beef CLA diet and a synthetic CLA diet. The amount and type of CLA in the synthetic and beef diets are similar and the synthetic CLA diet is acting as a positive control. The predominant and natural type of CLA in beef is c9, t11-CLA when cattle are grass fed. Therefore, the positive control group (synthetic CLA), provides an equivalent amount of c9, t11-CLA, to determine the efficacy of the beef CLA.

High-CLA beef protects against diabetes.

Obese mice (ob/ob) were used in the studies because they have diabetes which is very similar to obesity induced diabetes in man. The research team showed that feeding high-CLA beef to these mice cured many components of diabetes.

To explain the molecular mechanisms that underlie the apparent health benefits, the researchers looked at gene and protein expression in three tissues that play key roles in obesity and diabetes; adipose tissue (fat), liver and skeletal muscle. RNA and

protein was extracted from these tissues and the team identified a number of genes and proteins that are expressed differently in the mice fed high-CLA beef.

Interestingly, transcriptomic and proteomic profiling show that key pathways regulating the metabolism of glucose, fatty acids and energy, inflammation and oxidative stress are influenced by diets high in CLA. Several genes and proteins in each of these pathways were improved by feeding high-CLA.

What's next?

Further analysis of the diabetes study is ongoing to identify signatures of health, which can be induced using functional food products.

In addition, work will also focus on the effects of feeding a high-CLA beef diet on atherosclerosis. Again transcriptomic profiling of multiple genes will be used to identify signatures of health relevant to atherosclerosis.

Project duration 1/12/2006 to 30/11/2011

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