Computer models predict dietary effects on health

The EU project ETHERPATHS develops computer assisted models to study the dietary effects mediated by gut microbiota on lipid metabolism, with the aim to accelerate the development of health-promoting foods.

THE ETHERPATHS project focuses on the balance of lipid metabolism in the body, the effects of foods in tissues and the role of gut microbiota in these processes. Lipid metabolism disorders are associated with several common healthcare problems, such as ageing, diabetes and cardiovascular diseases. The balance can be influenced by dietary means. The risk of chronic diseases decreases with a diet containing particularly omega-3 fatty acids and foods that contain fibres and phenol.

Therefore, fatty fish, berries, fruits and vegetables may be favourable foods in terms of lipid metabolism balance. The body's own phospholipids are assumed to mediate the health-promoting effects, but their mechanisms of action are still unknown.

The project develops computer-assisted models that emulate the changes in lipid metabolism brought about by eating fish and vegetable oil, berries, fruits and vegetables. The use of models makes it easier to combine data from animal studies and cell-level data in the interpretation of research data from clinical trials, thus promoting research in the health effects of foods and development of foodstuffs. The results of the project and the tools developed in it will in time also be available, in addition to food companies, to companies and research institutions that develop diagnostics of health and disease.

The ETHERPATHS project is coordinated by Research Professor Matej Oresic at VTT Technical Research Centre of Finland, the biggest contract research organisation in Northern Europe. The total project budget for 2009–2012 is EUR 8 million, of which VTT's share is EUR 2.5 million. The project involves a total of 10 European research institutions and companies.

Project partners
The ETHERPATHS project is part of the EU FP7 Cooperation Work Programme: Food, agriculture and fisheries, and biotechnology programme (KBBE-2007-2-2-08).
The project partners are: VTT (Finland), University of Barcelona (Spain), University of Gothenburg (Sweden), University of Cambridge (United Kingdom), Institute for Systems Biology SPb (Russia), Federico II University of Naples (Italy), Noray Bioinformatics S.L.U. (Spain), BioMotif AB (Sweden), Advion Biosciences, Ltd. (United Kingdom) and Nestle Research Center (Switzerland).

Could a change of gut bacteria make people lose weight?

When obese people went on a diet and lost up to a quarter of their body weight, their gut flora changed too, becoming more like those of lean people.

METAGENOMICS The EU project – Metagenomics of the Human Intestinal Tract (MetaHIT) – is investigating the links between gut bacteria and obesity and inflammation. Research has already found a big difference between the bacteria population in the guts of fat and thin people. Moreover, when obese people went on a diet and lost up to a quarter of their body weight, their gut flora changed too, becoming more like those of the lean group.

So, could giving more of the lean type of gut bacteria to fat people help them lose weight? That is one of the questions the project hopes to answer. There is evidence it may. Certain probiotics can affect the production of bile acids, which in turn affect how much fat people absorb.

MetaHIT is also looking at how metabolites in the gut influence the efficacy of drugs in patients with inflammatory bowel disease. Certainly gut bacteria and inflammation are intimately entwined. Marika Kullberg of the University of York recently described how a molecule produced by one type of bacteria can calm the inflamed guts of mice.

She suggests that a massive rise in inflammatory bowel disease in recent years may be the penalty we are paying for such medical advances as antibiotics, vaccines and improved sanitation. By banishing various parasites from the gut, people have made the bacterial response to any challenges far more inflammatory.

MetaHIT is a project financed by the European Commission under the 7th FP program. The consortium gathers 13 partners from academia and industry, a total of 8 countries. Its total cost has been evaluated at more than EUR 20 million and the funding requested from the European Commission has been set with an upper limit of EUR 11.4 million. The project was initiated on January 1, 2008, and will run for 4 years.

TMC Home.

patients with particular benefit found in the COPD patient group.

The effectiveness of this intervention is the result of a complex interaction of Telehealth and other supports services, in particular specialist support nurses, whom have meshed to provide patients with a highly desirable support service and excellent patient satisfaction. The company was able to calculate the savings made basing themselves on the outcomes of the local pilots utilising TeleMedCare solutions.

It is believed that additional savings may arise when the schedule of resources will have been calculated to operate the new business model. Even if the sensitivity was set at only achieving 40%, the calculated saving achieved would still exceed GBP 2 million.

"I like to look at my readings – to check them out you see, if my oxygen's low I might just stay at home and sit down – you see I know I need to have more of my oxygen then. But if its good I know today's a good day for getting my jobs done. I don't know what I will do with out it," says A COPD patient using TeleMedCare Home System.

During the NHS Norfolk pilot benefits in improvement of quality of life were demonstrated for both patients and carers. For example, a 75-year-old widow, cared for by her daughters, entered the Telehealth service having had 7 acute admissions and 2 A&E attendances for COPD within a 12-month period, a total of 103 bed days. The installation of a Telehealth monitor enabled community staff to identify medication management issues, predict and manage exacerbations proactively and educate her to understand and control her exacerbations through medication and the use of bronchodilators.

Using Telehealth, her quality of life improved significantly. She is now able to recognise changes in her health and self-manage her medication. Her lifestyle also dramatically improved as she and her daughters are now able to go away on holidays – they all now live a more stress free life.

"It's great to see Mum up and about smiling again. TeleMedCare has freed up time for me to spend with my own children and also given me peace of mind that Mum's health is being better managed by both herself and the NHS," says a Carer of a patient using the TMC Home System.

"We are at a very exciting time. A large number of our pilot sites have now come to an end, with all showing positive signs to mainstream Telehealth. With our new generation technology already launched, TeleMedCare is set to benefit from all the hard work and investment of the last few years," says Saneth Wijayaratna, Sales and Marketing Director at TeleMedCare.

	Before TeleMedCare	With TeleMedCare	% Reduction
Total Bed Days	203	60	70%
A & E attendances	11	3	73%
GP Consultations	75	35	54%
GP Surgery nurse appointments	28	16	43%
GP Home Visits	27	17	38%

SANETH WIJAYARATNA
Sales & Marketing Director
Telemedcare Ltd

Life science at the heart of the UK's research hub

The world faces many challenges that advanced biotechnology can answer. Unmet medical needs, food and environmental hazards can all be alleviated by solutions embedded in the very fabric of life. One of the world's strongest regions regarding biotech research and innovation is located in the East of England.

CLUSTER Ever since James D Watson and Francis Crick walked into the Eagle pub in Cambridge on February 28, 1953, and announced: 'we've found the secret of life' after figuring out the structure of DNA, Cambridge has been a strong centre of modern life science research.

Watson and Crick received the 1962 Nobel Prize in Physiology or Medicine, along with Maurice Wilkins, for their body of research on nucleic acids. They were one of 42 Nobel Prize winners in medicine and chemistry coming from the Cambridge region.

The East of England has one of the highest long-term economic growth rates in the UK. The region forms part of the Greater South East (alongside London and South East England) and combined comprises the 10th largest economy in the world – a powerful force. The East of England is the UK's fastest growing regional economy, creating 10% of the UK's GDP and one of three positive contributors to the British economy.

The region also has one of the fastest growing populations in the UK, likely to rise to over six million by 2021. The East of England features diverse characteristics: medium-sized cities and their hinterlands, which increasingly drive economic growth in the region; rural areas, with the premier agriculture, food processing and biofuels locations in the UK; and coastal areas, rich in cultural and natural assets and tourist destinations.

The East of England is the most research and development-intensive region in the UK and is ranked as the top location for commercial R&D with 25% of the national total – more than three times the national average. There are strong global life sciences and technology clusters and leading corporate research facilities, including Unilever and GlaxoSmithKline (GSK).

Naturally, a lot of the scientific efforts in the region are clustered around the seven universities including the University of

Cambridge, the second-oldest university in the English-speaking world and which has produced no less than 83 Nobel Laureates. In addition, four national research institutes sponsored by the UK Biotechnology and Biological Sciences Research Council (BBSRC) are located in the region: John Innes Centre, Institute of Food Research, Rothamsted Research and Babraham Institute.

With a strong track record of success in drug discovery, the region has one of Europe's leading pipelines in several key therapy areas, including particular strengths in the CNS, oncology and respiratory. Funding of translational research is targeted to reach GBP 890 million between 2010-2011.

One example of the region's efforts in propelling the discovery of new, biologically based, therapeutics is East of England Stem Cell Network, an initiative funded by the East of England Development Agency (EEDA). The Eastern region has a large number of centres of excellence in all aspects of stem cell medicine and research, and the network links the 150 or so academic, medical and commercial partners to foster collaboration and ensure that the region continues to play a key role in this area, nationally as well as internationally.

Improved food security

In an effort to provide genome sequencing to underpin advances to improve food security, protecting UK agriculture from exotic animal disease and exploit weaknesses in microbes to develop new ways to kill super bugs, the Genome Analysis Centre (TGAC) is based on the Norwich Research Park, on the site of the John Innes Centre.

TGAC is a BBSRC national centre in partnership with EEDA, Norfolk County Council, South Norfolk Council, Norwich City Council, and the Greater Norwich Development Partnership, totalling a GBP 13.5 million investment.

"Genomic technology has enormous promise. The new Genome Analysis Centre will help to develop UK capacity in this area, where we are already a world leader," says Lord Drayson, Minister of State for Science and Innovation, adding: "I am delighted that the centre will work closely with industry to develop our economic potential in such disciplines as bioinformatics and metagenomic sequencing."

The facilities, which have been redesigned and renovated specifically for this purpose, are available to UK companies, as the centre exploits relevant commercial opportunities. TGAC represents a significant investment in the latest range of genome sequencing and bioinformatics technology and is highly complementary to the work of other genomics centres in the UK. It will provide the country's research base with a major resource by concentrating on plants, animals and microbes.

"By understanding the genetic makeup of these organisms and combining this with the latest computing techniques we can make a huge contribution to the economic and social wellbeing of the UK in the coming decades," says Dr Jane Rogers, Director of TGAC.

Bioscience underpinning the low carbon economy

Climate change affects us all and the world needs to act now to drastically reduce the carbon output. Each year, about nine tonnes of CO2 is released for every person in the UK and it is estimated that cuts of CO2 emissions by 60% is necessary to stop the worst effects. Understanding the role played by plants and microbes in the global biogeochemical cycles of carbon, nitrogen, phosphorus and sulphur is critical to developing technologies and creating the necessary policies to reduce greenhouse gas emission. One exciting area of research currently being explored through the Earth and Life Systems Alliance (ELSA) at the John Innes Centre and University of East Anglia (UEA), is how biochar can contribute not only to locking away carbon, but also increasing the quality of soils and increasing yields.

UEA has established the Low Carbon Innovation Centre as a gateway to access the expertise and knowledge developed in the UEA's research base that will underpin the progression of the UK economy towards a low-carbon sustainable future.

The Carbon Connections Development Fund managed by UEA and funded by the Higher Education Funding Council for England has been set up to seek out, encourage and invest in carbon-saving innovation either through technological advance or behavioural change. Carbon Connections is based in the Low Carbon Innovation Centre.

Also, the Carbon Reduction programme (CRed) was set up as a direct result of the UEA's focus on outreach activity. It is also part of the Low Carbon Innovation Centre and is based in the double-five-star rated School of Environmental Sciences with the aim of encouraging individuals and businesses to take practical action to reduce their carbon footprint.

The region also benefits from a dedicated incubator, a joint initiative between The Carbon Trust and The Technology Partnership (TTP), Europe's leading independent technology development company. The TTP Incubator provides a portfolio of consulting services to accelerate the development of start-up and early-stage businesses in the low carbon sector. Business Secretary Peter Mandelson recently announced GBP 20 million of UK Government backing for a new GBP 30 million Enterprise Capital Fund (ECF) to be managed by TTP Ventures, the specialist early stage venture investor and part of the TTP Group.

Business environment

Given the strong presence, long tradition and high level of research in the life sciences in the East of England it is no wonder that many of the world's biggest and most successful pharmaceutical companies, such as GSK, Pfizer and Astra Zeneca, have established themselves in the region.

EEDA and East of England International are aimed at furthering collaboration between academia and business and are great resource centres providing free consultation and help in finding partners and funding. Much of this is centred round a number of 'Enterprise Hubs' – centres of research and business excellence, with a focus on helping companies grow and thrive.

Key information on the East of England

Companies: 230 engaged in biotechnology, biopharma and/or medicinal chemistry; Over 150 actively involved in medical device sector.

- Gross value added (GVA): GBP 109.9 billion (9.7% of the UK total).
- GVA per head: GBP 19,599 (UK average: GBP 18,631).
- Employment rate: 77.2% (UK rate: 74.4%).

Source: East of England Development Agency (All statistics dated April 2008).

BBSRC

The Biotechnology and Biological Sciences Research Council (BBSRC) is the UK funding agency for research in the life sciences. Sponsored by Government, BBSRC annually invests around £420 million in a wide range of research that makes a significant contribution to the quality of life for UK citizens and supports a number of important industrial stakeholders including the agriculture, food, chemical, healthcare and pharmaceutical sectors.

BBSRC carries out its mission by funding internationally competitive research, providing training in the biosciences, fostering opportunities for knowledge transfer and innovation and promoting interaction with the public and other stakeholders on issues of scientific interest in universities, centres and institutes.

The Babraham Institute, Institute for Animal Health, Institute of Food Research, John Innes Centre and Rothamsted Research are Institutes of BBSRC. The Institutes conduct long-term, mission-oriented research using specialist facilities. They have strong interactions with industry, Government departments and other end-users of their research.

The Medical Research Council (MRC)

The Medical Research Council's (MRC's) IP and expertise have been acquired by many companies including AstraZeneca, Boehringer Ingelheim GmbH, Cambridge Antibody Technology (CAT), Abbot, Genzyme, GlaxoSmithKline, Medimmune, Merck Co. Inc., Merck KGaA, Pfizer and Roche, to name but a few.

MRC has participated in the creation of 17 start-ups, including two of the UK's largest and most successful biotechnology companies: UCB-Celltech and CAT.

Twelve of MRC's 28 units in the UK are located in Cambridge:

- MRC Laboratory of Molecular Biology (LMB)
- MRC Dunn Human Nutrition Unit
- MRC Collaborative Centre for Human Nutrition Research
- MRC Cognition and Brain Sciences Unit
- MRC Centre for Stem Cell Biology and Regenerative Medicine
- MRC Centre for Protein Engineering
- MRC Centre for Obesity and Related Metabolic Diseases
- MRC Centre for Nutritional Epidemiology in Cancer Prevention and Survival (CNC)
- MRC Centre for Behavioural and Clinical Neuroscience Institute (BCNI)
- MRC Cancer Cell Unit
- MRC Epidemiology Unit
- MRC Biostatistics Unit

Stem cell therapy for treatment of deafness

A new study has successfully isolated human auditory stem cells from foetal cochleae and found they had the capacity to differentiate into sensory hair cells and neurons.

STEM CELLS Deafness affects more than 250 million people worldwide. It typically involves the loss of sensory receptors, called hair cells, for their 'tufts' of hair-like protrusions, and their associated neurons. The transplantation of stem cells that are capable of producing functional cell types might be a promising treatment for hearing impairment, but no human candidate cell type has been available to develop this technology.

A new study led by Dr. Marcelo N. Rivolta, Senior Research Fellow at the University of Sheffield has successfully isolated human auditory stem cells from foetal cochleae (the auditory portion of the inner ear) and found they had the capacity to differentiate into sensory hair cells and neurons. The study is published in the April issue of STEM CELLS.

The researchers painstakingly dissected and cultured cochlear cells from 9-11 week-old human foetuses. The cells were expanded and maintained in vitro for up to one year, with continued division for the first 7 to 8 months and up to 30 population doublings, which is similar to other non-embryonic stem cell populations, such as bone marrow. Gene expression analysis showed that all cell lines expressed otic markers that lead to the development of the inner ear as well as markers expressed by pluripotent embryonic stem cells, from which all tissues and organs develop.

They were able to formulate conditions that allowed for the progressive differentiation into neurons and hair cells with the same functional electrophysiological characteristics as cells seen in vivo.

"The results are the first in vitro renewable stem cell system derived from the human auditory organ and have the potential for a variety of applications, such as studying the development of human cochlear neurons and hair cells, as models for drug screening and helping to develop cell-based therapies for deafness," say the authors.

Optimise differentiation

Although the hair cell-like cells did not show the typical formation of a hair bundle, the authors suggest that future studies will aim to improve the differentiation system. They are currently working on using the knowledge gleaned from this study to optimise the differentiation of human embryonic stem cells into ear cell types.

"Although considerable information has been obtained about the embryology of the ear using animal models, the lack of a human system has impaired the validation of such information," the authors note.

"Access to human cells that can differentiate should allow the exploration of features unique to humans that may not be applicable to animal models," says Donald G. Phinney, co-editor of the journal. The protocol they developed to expand and isolate human foetal auditory stem cells may be able to be adapted for deriving clinical-grade cells with potential therapeutic applications.

Dr Ralph Holme, director of biomedical research for Royal National Institute for Deaf and Hard of Hearing People, says: "There are currently no treatments to restore permanent hearing loss so this has the potential to make a difference to millions of deaf people."