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Health Benefits of Cheese

Key external stakeholders:

Cheese manufacturers, dairy industry, food & health researchers and policy makers

Practical implications for stakeholders:

There is a growing awareness among consumers of the importance of nutrition to health and that many foods naturally include bioactive molecules that provide health benefits in excess of basic nutrition. There is also an understanding that cheese, when consumed as part of a well-balanced diet, can provide a significant portion of our basis nutritional needs. However, there is some concern that due to its relatively high fat content cheese may have an overall negative impact on health. However, the outcomes of this project, that focused on elucidating potential health associated with commercial Irish Cheddar cheese, have indicated that there may be many health benefits associated with cheese consumption that include:

- In a controlled human feeding study, serum total cholesterol and LDL cholesterol were reduced when dairy fat was consumed in the form of Cheddar cheese
- Commercial Cheddar cheese was demonstrated to contain a number of bioactivities including antioxidant activity and the ability to stimulate the release of insulin (important in blood glucose management and metabolic control) and glucagon-like peptide-1 (GLP-1) (important in appetite control) in cell culture assays.

Main results:

Consumption of Cheddar cheese resulted in decreased total serum cholesterol and LDL cholesterol

Cheese was demonstrated to contain a number of important bioactivities that were present throughout ripening and in some situation increased as ripening time progressed

Opportunity / Benefit:

This project established a platform for cheese nutrition research which can now be exploited by the dairy industry to further elucidate health benefit associated with cheese. The information generated can be used to promote cheese consumption as part of a well-balanced diet.

Collaborating Institutions:

UCD, UCC

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1. Project background:

Cheese, of which there are over 1,000 varieties, has been part of the human diet since Neolithic times. It is a nutritious food; which when consumed as part of an overall balanced diet can contribute a significant portion of the daily requirements for protein and fat as well as a number of important minerals and vitamins. It is a particularly good source of calcium in a bioavailable form and a 50g serving depending on variety can provide up to 400mg of calcium equivalent to 38% of daily needs. However, as cheese contains added sodium and it is a relatively high fat energy dense food, there is some concern that its consumption should be limited due to potential health implications. Furthermore, most public health organisations currently recommend reduction in total fat and in particular saturated fat in the western diet. In cheese such as Cheddar 66% of the fatty acids are saturated, 30% are monounsaturated and 4% are polyunsaturated which has resulted in many consumers being concerned and some tending to reduce cheese intake.

However, many human intervention studies revealed that cheese intake resulted in lower blood total and LDL cholesterol concentration, including reduction of triglycerides. Moreover, many studies suggest cheese intake had no impact on cardiovascular health and an inverse correlation between cheese intake and myocardial infraction, as well as an inverse association with the risk of stroke is reported. This unusual effect is attributed to the “matrix effect” of cheese, which describes the overall combination of nutrients and components present in a food and how they interact. This project will seek to elucidate the impact of the cheese matrix on a number of factors associated with cardiovascular disease, in particular blood cholesterol levels through a human feeding study.

Most cheeses, including Cheddar undergo extensive proteolysis during ripening resulting in the release of a diverse array of peptides and amino acids. It has been demonstrated that some of the peptides released can have associated bioactivity. This project will investigate if a number of such bioactivities are produced in Cheddar cheese during ripening. In particular we will focus on antioxidant activity and the potential of cheese to stimulate release of (i) insulin which is critical for blood glucose control and (ii) glucagon-like peptide-1 (GLP-1) which plays a role in appetite suppression.

2. Questions addressed by the project:

- Does cheese consumption impact key metabolic and cardiovascular health indices?
- Does cheese encode specific health beneficial bioactivities and how do they evolve during ripening?

3. The experimental studies:

To test the hypothesis that dairy fat consumed in a cheese matrix has a different impact on blood lipids than when consumed as butter, a six week random parallel intervention study (N=164 volunteers) was undertaken where each volunteer received 40g of dairy fat per day with a standardized amount of dairy protein and calcium either as (i) full-fat Cheddar, (ii) reduced-fat Cheddar plus butter, (iii) butter plus calcium caseinate powder plus a calcium supplement or (iv) volunteers underwent a six week run in period during which all cheese was excluded from their diet followed by intervention (i). Following these interventions a range of anthropometric and blood biochemistry measures were undertaken including total, LDL and HDL cholesterol and total triglycerides.

To establish if Cheddar cheeses contains bioactives and to elucidate how ripening might impact on them, a selection of newly manufactured commercial full-, reduced- and low-fat Cheddar cheeses were obtained from three Irish dairy companies. The cheeses were ripened at 8°C for up to twelve months and samples were taken periodically from which water soluble extracts were prepared. Water soluble extracts contain free amino acids and small peptides released from casein molecules as a consequence of protein hydrolysis during ripening and bacterial metabolites produced by the cheese microbiota. These extracts were assayed for antioxidant activity and capacity to stimulate insulin release from pancreatic cells and glucagon-like peptide-1 (GLP-1) from enteroendocrine cells in tissue culture assays.

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4. Main results:

The key observations from the intervention study were that total and LDL cholesterol were significantly decreased in volunteers consuming full fat Cheddar. Interestingly, total and LDL cholesterol increased in group (iv) during the run in period when they were not consuming cheese but decreased following resumption of consumption of full fat Cheddar for the six week trial period. No difference in anthropometry, fasting glucose or insulin between the groups at pre- or post-intervention was observed.

The antioxidant capacity of all cheese samples increased during ripening, reaching peak activity by 8 to 10 months of ripening. Exposure to simulated gastric conditions resulted in increased activity in all samples, while exposure to simulated small intestine conditions resulted in a slight decrease in activity.

Stimulation of insulin secretion from pancreatic β-cells *in vitro* was observed at the single ripening time point tested for ~30% of the commercial Cheddar cheeses examined. A selection of these cheeses was examined for the ability to promote insulin secretion at different time points during 10 months of ripening. Each cheese continued to express this activity, some in excess of the positive glucose control; however, levels of stimulation did not follow a uniform pattern throughout ripening.

Nine of ten cheeses tested post six months of ripening, significantly stimulated secretion of GLP-1 from enteroendocrine cells. Following exposure of the cheese samples to simulated gastrointestinal digestion the capacity to stimulate GLP-1 secretion was lost. A mouse feeding study indicated that when the cheese extract was administered by oral gavage, cumulative food intake was reduced for six hours following administration, but then returned to normal cumulative intake levels.

5. Opportunity/Benefit:

The human feeding study has provided more evidence that Cheddar cheese consumption can have a positive effect on serum cholesterol levels and this is useful information for companies marketing this cheese and to health professionals when advising patients on nutrition.

Cheese was demonstrated to contain a number of important bioactivities which can be further explored to confirm their efficacy in human studies.

A platform for investigation of the health and nutritional benefits of cheese has been established which can be further exploited to understand the mechanisms involved.

6. Dissemination:

Main publications:

Feeney, E.L., Barron, R., Dible, V., Hamilton, Z., Power, Y., Tanner, L., Flynn, C., Bouchier, P., Beresford, T., Noronha, N., and Gibney, E.R. (2018) Dairy matrix effects: response to consumption of dairy fat differs when eaten within the cheese matrix—a randomized controlled trial. *Am. J. Clin. Nutr. 108: 667-674*

Kondrashina, A., Seratlic, S., Kandil, D., Treguier, N., Kilcawley, K., Schellekens, H., Beresford, T., and Giblin, L. (2018) Irish Cheddar cheese increases glucagon-like peptide-1 secretion in vitro but bioactivity is lost during gut transit. *Food Chem. 265: 9-17*

Popular publications:

Seratlic, S. (2016) Cheese is healthier than you thought. *Dairy Industries, Vol. 81, No. 3, March 2016.*

7. Compiled by:

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