

THIS ISSUE

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Glycemic Management & Diabetes: A Role for Dairy?

Type 2 diabetes mellitus (T2DM) is now recognised as a serious public health concern throughout the world. Additionally, the global prevalence of diabetes is forecast to continue to increase, while the World Health Organisation projects that diabetes will be the 7th leading cause of death in 2030. Indeed, wide-ranging health implications are associated with this chronic disease, including an increased risk of cardiovascular disease and microvascular problems such as retinopathy, nephropathy, and neuropathy. To note, the overwhelming majority (about 90%) of people with diabetes have T2DM. Considering such facts, research aimed at identifying factors that may positively impact glycemic control and help reduce the risk of T2DM is of significant relevance and importance.

Lifestyle and diet are proposed as key modifiable risk factors for T2DM, with research continuing to explore specific relationships. One such example, which is receiving increasing attention and recognition in recent years, is the potential impact of dairy and various dairy components.

A number of studies are indicating that dairy/specific dairy components may positively influence glycaemic management, with evidence from recent meta-analyses supporting the hypotheses that dairy may be associated with a reduced

risk of T2DM. Indeed, the nutritional value of dairy foods is well recognised, providing a matrix of nutrients and bioactives. Dairy components proving to be of interest with regards to glycemic control include, but are not limited to: calcium, whey, casein and, in the case of fortified dairy, vitamin D.

Granted, further research is required to understand more fully the potential roles for dairy, including further work on differentiating between the effects of individual dairy foods, as well as confirming/identifying the effective dairy components – ideally with a view to exploring their potential as functional ingredients, where appropriate. Nonetheless, evidence to-date is certainly revealing interesting and encouraging findings.

As part of its metabolic health programme, Food for Health Ireland (FHI) is evaluating milk-derived bioactives for their ability to improve blood sugar control and lower the risk of diabetes and its complications. "This FHI research aims to identify dairy-derived ingredients that can exhibit meaningful benefits with regards to glycemic management and type 2 diabetes," says Jens Bleiel, CEO of FHI. "Diabetes is an increasingly significant global health issue, and this work reflects FHI's commitment to improving health, wellness and quality of life through world-class innovation in food."

EDITORIAL

In this edition of *DN Forum*, we explore an area of research that is gathering significant pace and interest: the association of dairy and dairy components with glycemic management and type 2 diabetes mellitus. And, as evidence is indicating potentially beneficial effects, this is another example of how dairy may positively impact health.

Indeed, this edition leads nicely on from the July 2012 *DN Forum – Milk and Milk Products: the Association with the Metabolic Syndrome and Type 2 Diabetes* – which you may wish to revisit.

Again, we are delighted to highlight the fact that Irish researchers are actively working in this area. The Expert Review (pages 2-3) – prepared by Aoife Curran and Dr Lorraine Brennan, Food for Health Ireland and University College Dublin – provides an excellent summary of the research on this topic, as well as pointing to areas for future investigation.

Also, why not log on to the NDC (www.ndc.ie) and FHI (www.fhi.ie) websites for further information on dairy products and the various work programmes and activities of these organisations. I would particularly encourage you to check out the NDC's dairy education programmes for schools – these may be of particular interest to those of you working with young people. See page 4 for more details.

As always, we are delighted to hear from you and appreciate all your comments and feedback: nutrition@ndc.ie

Dr Catherine Logan
Nutrition Manager, The National Dairy Council (NDC)

Glycemic Management – Can Milk Bioactives Potentially Improve Blood Glucose Control and Therefore Decrease the Risk of Diabetes?



Aoife Curran



Dr Lorraine Brennan

Aoife Curran, PhD student in Food for Health Ireland (FHI)
 Dr Lorraine Brennan, Lecturer in University College Dublin (UCD)
 UCD Institute of Food and Health, UCD School of Agriculture and Food Science, Belfield, UCD, Dublin 4.

Introduction

The incidence of type 2 diabetes mellitus (T2DM) has increased rapidly on a global scale. Approximately 366 million people worldwide had diabetes in 2011, with this figure expecting to rise to 552 million by 2030^[1]. T2DM accounts for 90% of people with diabetes worldwide^[2]. T2DM occurs due to high levels of glucose being present in the blood (hyperglycemia), which is usually caused by a combination of insulin resistance and impaired insulin secretion^[2]. A recent systematic review and dose-response meta-analysis suggests that high consumption of dairy products decreases the risk of T2DM and positively influences the glycemic profile in humans^[3].

Milk and bioactives

Milk is thought of as a nutritious food, as it is an excellent source of a balanced range of amino acids. Milk contains two primary sources of protein, casein (80%) and whey (20%), which ultimately have different effects on plasma amino acid profiles^[4]. Casein is digested slowly and, therefore, proteins are slowly broken down into amino acids. On the other hand, whey protein is digested quickly, leading to a more rapid increase in plasma amino acids^[4]. Whey protein has been suggested to bring about positive insulinotropic (insulin secretion) effects and lower blood glucose levels in humans following ingestion^[5]. The main proteins in whey are β -lactoglobulin, α -lactalbumin, proteose peptone, immunoglobulins, bovine serum albumin, lactoferrin and lactoperoxidase. Bioactive peptides are formed during whey and casein protein digestion^[4]. Bioactive peptides are defined as particular protein fragments that have a beneficial impact on body functions or conditions, and may potentially have a positive influence on health^[6].

Dairy products and glycemic control

A recent meta-analysis concluded that a high intake of dairy products was associated with a significantly lower risk of T2DM^[3]. The combination of 17 studies suggests that significant inverse associations exist between intakes of dairy products, low-fat dairy products and cheese, and the risk of T2DM. Nine studies were included in the dose-response analysis of low-fat dairy products, those who had a high intake of dairy products had a lower risk of developing T2DM in comparison to those that had a low dairy intake (relative risk (RR) 0.83)^[3]. Seven cohort studies were included when comparing high and low milk intake, and the results demonstrate a trend that subjects with high milk consumption were at a decreased risk of T2DM in comparison to those with low milk consumption (RR 0.87)^[3]. Focusing on three low-fat/skim milk studies revealed significant inverse associations for high compared to low intakes (RR 0.82). Additionally, a meta-analysis by Tong *et al.* suggested that increased consumption of total and low-fat dairy products may decrease the risk of T2DM by 5% and 10% respectively^[7].

A number of prospective cohort studies have investigated the relationship between dairy products and glycemic management^[8-15] (Table 1). Overall, results appear promising for an inverse association between dairy products and risk of T2DM^[8-13].

Prospective Cohort Study	Main outcomes
Sluijs <i>et al</i> ^[8]	Intake of total dairy not associated with T2DM. Inverse association of cheese and combined fermented dairy products with T2DM.
Choi <i>et al</i> ^[9]	Dairy intake associated with a modest reduced risk of T2DM. Each serving per day increase in total dairy intake associated with a 9% lower risk of T2DM.
Grantham <i>et al</i> ^[10]	Significant inverse association between high dairy intake and T2DM risk in men (odds ratio 0.53). Low-fat milk inversely associated with T2DM risk (odds ratio 0.65).
Fumeron <i>et al</i> ^[11]	High consumption of dairy products (excluding cheese) associated with decreased incidence of impaired fasting glucose and T2DM.
Kirii <i>et al</i> ^[12]	Consumption of dairy significantly associated with a decreased risk of T2DM in women only.
Liu <i>et al</i> ^[13]	Low-fat dairy intake associated with a decreased risk of T2DM.
Soedamah-Muthu <i>et al</i> ^[14]	Total dairy intake and dairy product sub-types were not associated with incident T2DM after a 10-year follow-up.
Elwood <i>et al</i> ^[15]	Significant inverse association between milk consumption and the metabolic syndrome in men. No significant trend between milk intake and T2DM.

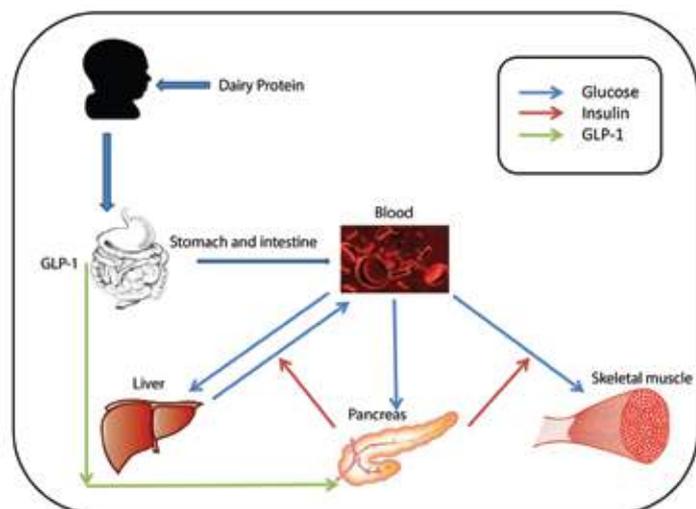
▲ Table 1: Review of prospective studies on dairy products and T2DM.

However, it should be noted, some studies have not shown an association between dairy consumption and T2DM risk^[14, 15].

Evidence from acute interventions

While strong evidence exists from cohort studies, there is a lack of randomised controlled trials (RCTs) examining dairy consumption and the risk of T2DM. A recent RCT examined the effects of long-term (six month) dairy consumption on metabolic health in 23 healthy volunteers^[16]. High dairy consumption (four servings per day) was associated with significantly improved plasma insulin and insulin resistance in comparison with the low dairy (max. two servings per day) group. Bodyweight, composition, blood lipid, blood glucose and blood pressure measurements did not differ significantly between groups following the intervention. A limited number of acute intervention studies have been

orchestrated examining the link between milk proteins and glycemic management^[17]. Ten healthy subjects took part in an acute RCT in which various doses of whey protein were added to a 50g glucose drink and consumed by subjects^[4]. The results of the trial demonstrated a decrease in postprandial glycemia in a dose-dependent fashion when whey protein was added to the glucose drink. Furthermore, the effects of supplementation of high-glycemic index breakfast and lunch with whey proteins, was investigated in T2DM subjects^[18]. Insulin responses were observed to be higher after both meals when whey was included in the test meals in comparison to the control. Following the consumption of lunch, the blood glucose response was found to be significantly lower after ingestion of whey supplementation. GIP (gastric inhibitory protein) also increased following whey ingestion, which suggests that whey consumption may activate the incretin system and these hormones may therefore also positively influence glycemic management. More recently the effects of a casein hydrolysate on glycemic control in an acute setting has been reported^[19]. Consumption of the casein hydrolysates exerted a small positive effect on glucose and insulin levels in T2DM subjects in a dose response manner. Overall, from these studies evidence is mounting for the positive health benefits of milk proteins and peptides in acute studies. Moreover, bioactive peptides and amino acids have the ability to stimulate insulin secretion directly and also indirectly by release of gut hormones (**Figure 1**).



▲ Figure 1: Potential impact of dairy proteins in the context of glycemic management.

Conclusion

In the literature, there is growing evidence from prospective cohort studies that there is a link between dairy intake and risk of T2DM. However, a current limitation is the lack of RCTs in this area^[20]. Notwithstanding this, there are a number of recent human studies that have examined the effects of milk proteins and milk hydrolysates on glycemic management. Although a number of acute studies have been undertaken, further studies are necessary to examine potential long-term effects of dairy products on glycemic control. After vigorous study and testing, bioactive peptides may ultimately be used in the production of functional foods and nutraceuticals due to their beneficial effects on health status^[5].

Food for Health Ireland (FHI) (www.fhi.ie)^[21] is a leading global innovation centre for the development of nutritional functional ingredients to improve health, wellness and quality of life. It links the scientific capabilities of Irish academic partners (UCD, UCC, UL, DCU, NUIG, NUIM, Teagasc) with the Irish food industry. FHI researchers at UCD are currently testing milk-derived bioactives for their capabilities to improve blood glucose control, and therefore decrease the risk of T2DM and its comorbidities, if incorporated into a functional food.

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Key Points

- Type 2 diabetes mellitus (T2DM) occurs due to high levels of glucose being present in the blood (hyperglycemia), which is usually caused by a combination of insulin resistance and impaired insulin secretion. Significant health consequences are associated with diabetes including an increased risk of cardiovascular disease, as well as organ-specific implications e.g. retinopathy and nephropathy.
- As the prevalence of T2DM continues to increase on a global level, research is exploring possible interventions and approaches, which may positively impact glycaemic control and help reduce the risk of T2DM. The role of dairy and dairy components in this area has gathered significant pace and momentum in recent years as numerous studies indicate potentially beneficial effects.
- Meta-analyses of cohort studies support the hypothesis that dairy products are associated with a reduced risk of T2DM, with significant associations also noted for low-fat dairy. Additionally, a recent randomised controlled trial on dairy consumption and metabolic health, along with acute interventions studies on milk proteins and glycaemic management, are revealing encouraging results.
- Specific dairy components that are proving to be of interest with regards to glycaemic control include: calcium, whey, casein and, in the case of fortified dairy, vitamin D. Additionally, the effects of specific dairy foods on glycaemic control has been identified as an area requiring further research.
- As part of its metabolic health programme, Food for Health Ireland is working to identify milk-derived bioactives capable of improving blood sugar control and subsequently lowering the risk of diabetes and its complications.

Other Resources of Interest

DAIRY EDUCATION PROGRAMMES FOR SCHOOLS



Moo Crew, the Primary Dairy Movement, is an exciting initiative from the National Dairy Council whereby pupils explore the benefits of a healthy, balanced diet and an active lifestyle. Designed for 3rd to

6th classes, pupils will learn all about nutrition and healthy eating, the benefits of exercise, and explore where dairy comes from in its journey from farm to fridge. Key features of this initiative include: lesson plans, fun activities and interactive classroom resources.

www.moocrew.ie



The NDC Milk It Awards challenge secondary school students from 1st to 6th year to form their own advertising agency in their school to create a campaign to promote the importance of dairy to their peers.

This national initiative is intended to be a fun and engaging way for teenagers to learn about the nutritional benefits of the 'milk, yogurt and cheese' food group, while offering cross-curricular applications for both teachers and students. This year's Pitch Deadline is 22nd Nov...so better hurry!

www.milkitawards.ie

Contact us....

THE NATIONAL DAIRY COUNCIL (NDC)

The National Dairy Council,
Innovation House,
3 Arkle Road, Sandyford Industrial Estate,
Dublin 18.
Tel: +353 (0)1 290 2451
Email: info@ndc.ie
Web: www.ndc.ie



Mission: To deliver real and unique value to Irish dairy farmers by protecting and promoting the image, quality, taste and nutritional credentials of Irish dairy produce to a wide variety of audiences in a clearly defined, focused, unique and effective manner.

FOOD FOR HEALTH IRELAND (FHI)

Food for Health Ireland,
University College Dublin,
Dublin, Ireland.
Tel: +353 (0)86 781 5590
Email: jens.bleiel@ucd.ie
Web: www.fhi.ie



Mission: To leverage the world-class capabilities of the Irish academic partners, with the market expertise of the industry partners, into a pipeline of innovative, nutritional functional ingredients/products for the global food industry.

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