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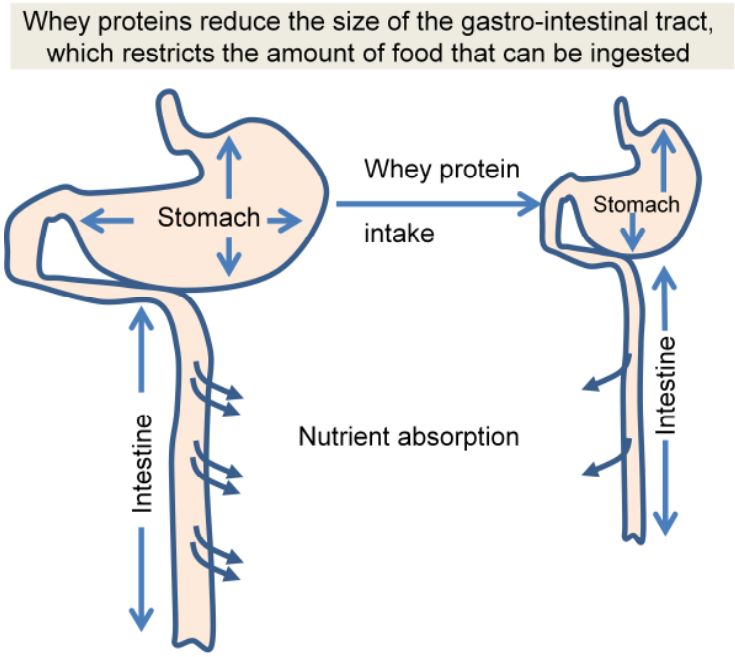
Anti-obesity effects of WPI are mediated through the gastro-intestinal tract



Key external stakeholders:

Dairy industry, policymakers and food manufactures.

Practical implications for stakeholders:

- Creation of whey protein isolate-enriched food ingredients or ready-made food products with anti-obesity properties

Main results:

- Whey proteins reduced weight gain compared to casein intake.
- Whey proteins reduced the size of the gastro-intestinal tract, which appeared to restrict the amount of food that can be ingested to support weight gain.

Opportunity / Benefit:

We have established an *in vivo* model that can be used to test the efficacy of whey proteins to counteract the obesogenic effects of wide variety of commercially available food products.
The data provide the basis to create whey protein enriched food ingredients or ready-made food products that can reduce weight gain.

Collaborating Institutions:

University College Cork (Ireland), University College Dublin (Ireland), University of Helsinki (Finland) and Chinese Academy of Science (China).

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1. Project background:

The prevalence of obesity is increasing worldwide. In 2008, the World Health Organisation reported that over 200 million men and almost 300 million women were obese. Equally alarming is the finding that obesity increases the risk of development of several clinical conditions including diabetes, cardiovascular disease and several forms of cancers. In 2008, these non-communicable diseases caused 63% of all deaths.

Because of the considerable economic and health care cost of managing obesity, there is a growing worldwide interest to develop interventions that could prevent the development of obesity. Teagasc responded to this challenge in 2009 by initiating the Vision programme on Obesity, the aim of which was to identify dietary interventions to prevent the development of obesity. This project was a component of this programme, which focused on whey proteins and their effects on weight gain.

Whey is a by-product of cheese manufacture, and it contains minerals, vitamins and proteins. Whey associated proteins include beta-lactoglobulin, alpha-lactalbumin, glycomacropeptide, serum albumin and lactoferrin. These proteins have gained a considerable commercial interest because of their ability to reduce weight gain when incorporated as part of the human and rodent diets.

At the commencement of the current project there was evidence from short term *in vivo* (up to 1 week) and *in vitro* studies that whey proteins induce satiety (reduction in meal number) and satiation (reduction in meal size), which decreases food intake and in turn body weight. However, it was not known if the satiation/satiety related mechanisms could account for the changes in body weight seen with long term intake of whey proteins.

Here, we set out to identify the mechanisms by which whey proteins reduce body weight, with specific focus on mechanisms affected by long term intake of whey proteins.

2. Questions addressed by the project:

- Could whey proteins reduce weight gain over a long period of time (up to 21 weeks)?
- Are whey proteins effects on body weight affected by the fat content in the diet?
- What are the mechanisms involved for the whey protein effects on body weight?

3. The experimental studies:

Mice were used to model human obesity, because, like humans, mice also gain weight when fed a high energy cafeteria-like diet, and develop insulin resistance. We fed mice whey protein isolate (WPI) as part of low or high fat diets, to mimic the range of fat content in the diets available for human consumption, and assessed the effectiveness of WPI to prevent weight gain in comparison to mice fed similar diets but in which WPI was replaced by casein. The studies lasted for 8-21 week duration to determine the mechanisms by which WPI affected weight gain over time.

4. Main results:

- Mice fed WPI show reduced weight gain compared to mice fed casein
- The above effect was independent of the fat content in the diets.
- WPI reduced the size of the gastro-intestinal tract, which limited the amount of food that can be ingested. This appeared to underlie the reduced weight gain seen with WPI intake, rather than satiety or satiation effects.

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5. Opportunity/Benefit:

Much attention has focused on identifying the bioactivity associated with milk proteins that can reduce weigh gain by causing satiety and satiation. We have identified a new mechanism by which whey proteins reduce long term weight gain, involving the gastro-intestinal tract, where whey proteins effects on these tissues limited the amount of food that can be ingested to support weight gain. Thus, the dairy and Functional Food Industry in Ireland has the opportunity now to focus on WPI, which can be sourced from cheese manufacture, and develop protein enriched food ingredients or ready-made food products targeting the over-weight and obese populations. The *in vivo* model that has been established in Teagasc, can be exploited to test the efficacy of whey protein enriched food products to counteract the obesogenic effects of wide variety of commercially available food products. The data will allow to establish health claims for whey protein enriched food products.

6. Dissemination:

Main publications:.

1. McAllan, L., Keane, D., Schellekens, H., Roche, H.M., Korpela, R., Cryan, J.F. and Nilaweera, K.N. (2013) 'Whey protein isolate counteracts the effects of a high-fat diet on energy intake and hypothalamic and adipose tissue expression of energy balance-related genes'. *British Journal of Nutrition* 110: 2114-2126.
2. McAllan L., Skuse, P, Cotter, P.D., O'Connor, P., Cryan, J.F., Ross, R.P., Fitzgerald G., Roche, H.M., and Nilaweera, K.N. (2014) 'Protein quality and the protein to carbohydrate ratio within a high fat diet influences energy balance and the gut microbiota in C57BL/6J mice. *PLoS One* 9:e88904.
3. McAllan, L, Speakman, J.R., Cryan, J.F. and Nilaweera, K. (2015). Whey protein isolate decreases murine stomach weight and intestinal length and alters the expression of *Wnt* signalling associated genes'. *British Journal of Nutrition* 113, 372-379.

Popular publications:

TResearch publications
http://www.teagasc.ie/publications/view_publication.aspx?publicationID=3433
http://www.teagasc.ie/publications/view_publication.aspx?publicationID=3086

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