

Project number: 6103
Funding source: Teagasc

Date: June 2016
Project dates: October 2011-
December 2015

Bovine serum albumin is a novel anti-obesity dietary protein



Key external stakeholders:

Dairy and meat industry, policymakers and food manufactures.

Practical implications for stakeholders:

- Creation of food ingredients or ready-made food products with anti-obesity bioactivity in bovine serum albumin

Main results:

- Bovine serum albumin reduced body weight and fat mass and increased lean mass compared to casein intake.

Opportunity / Benefit:

We have established for the first time that bovine serum albumin (BSA), a dietary whey protein, has anti-obesity effects.

The data provide the basis to use these proteins as functional food ingredients for humans and animals (e.g. pet industry to reduce unhealthy weight gain in domestic pets). Moreover, the data opens the opportunity to screen for the protein-derived bioactivity, which we anticipate will be more efficacious than the intact protein.

Collaborating Institutions:

University College Cork (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 can prevent the development of obesity.

Whey is a by-product of cheese manufacture, and it contains minerals, vitamins and proteins. Whey associated proteins include beta-lactoglobulin, alpha-lactalbumin, glycomacropeptide, BSA and lactoferrin.

In a previous Teagasc funded project (RMIS 5974), we established that the protein enriched form of whey called whey protein isolate (WPI) reduced weight gain associated with intake of energy dense high fat diets.

Here, we set out to identify the whey proteins providing the bioactivity to WPI.

2. Questions addressed by the project:

- What are the anti-obesity whey proteins?
- What are their mechanisms of action?

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 a number of whey proteins including BSA and lactoferrin as part of low or high fat diets, to mimic the range of fat enriched diets available for human consumption, and assessed the effectiveness of whey proteins to prevent weight gain in comparison to mice fed similar diets but where casein replaced the whey proteins in the diet. We measured body weight, fat mass and lean mass and hormones important for body weight regulation.

4. Main results:

- Mice fed BSA show reduced body weight and fat mass and increased lean mass compared to mice fed casein. Moreover, BSA reduced plasma levels of key hormones (leptin and corticosterone) associated with development of obesity.
- Mice fed lactoferrin did not alter the weight gain, fat or lean mass, but reduced the same hormones sensitive to BSA.

The data suggest that BSA and lactoferrin have common and distinct bioactivities, with latter causing changes in body weight and fat/lean mass.

5. Opportunity/Benefit:

Much attention has focused on WPI as a potential dietary solution to the obesity problem because of its anti-obesity potential and because these proteins can be sourced as by-products of cheese manufacture, thus reducing product formulation costs. We have discovered that a constituent protein, BSA, has more potent anti-obesity effects than WPI. These data provide the basis to develop food products with BSA to reduce weight gain in humans and animals including in domestic pets, where, like humans, the reduced physical activity and unhealthy diets have led to increased disease states. Our data also provide the basis to screen for the bioactivity in BSA, which we anticipate would be more efficacious than BSA in much the same way as BSA was more effective than WPI. The bioactivity once characterized will allow creation of food products with anti-obesity effects..

6. Dissemination:

Main publications:

1. McManus BL, Korpela R, O'Connor P, Schellekens H, Cryan JF, Cotter PD, Nilaweera KN. Compared to casein, bovine lactoferrin reduces plasma leptin and corticosterone and affects hypothalamic gene expression without altering weight gain or fat mass in high fat diet fed C57/BL6J mice. *Nutrition & Metabolism* 2015, Dec 8;12:53.
2. McManus BL, Korpela R, Speakman JR, Cryan JF, Cotter PD, Nilaweera KN. Bovine serum albumin as the dominant form of dietary protein reduces subcutaneous fat mass, plasma leptin and plasma corticosterone in high fat-fed C57/BL6J mice. *British Journal of Nutrition* 2015 August;114(94); 654-662.

7. Compiled by: Dr. Kanishka Nilaweera
