

Plenary 5: Body Weight Regulation

The role of dietary protein and macronutrients in acute appetite regulation

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Dietary protein induces greater satiety compared to carbohydrate. A mechanism to explain this has not been described, although gut hormones with a role in acute appetite regulation may be involved. The effect of macronutrients on appetite has been observed in lean subjects only and requires demonstration in the overweight population in whom appetite regulatory mechanisms may differ. Little is known about the influence of macronutrient source on this relationship, the duration of satiety after protein consumption and the impact of combining protein with carbohydrate.

This presentation will report on a series of studies conducted at CSIRO Human Nutrition which address these knowledge gaps. It will also include a summary of other recent findings in this area.

The overall objective of these studies was to compare the effect of various dietary proteins and carbohydrates on acute postprandial changes in appetite sensations, *ad libitum* energy intake and associated regulatory hormones in overweight/obese adults.

Study Design – Three randomised double-blind crossover studies examined the acute appetite response to preloads over 3-4h followed by a buffet meal. Studies were conducted at an outpatient research clinic. Overweight and obese, healthy men participated in all studies, with an additional group of lean men in Study 2. Interventions consisted of liquid preloads (1MJ, ~450mL) containing ~55g of dietary protein (whey, casein, soy, gluten), carbohydrate (glucose, lactose and fructose) or combined whey protein/fructose (Study 3). The primary outcome measures were fasting and postprandial plasma glucose, insulin, total ghrelin, glucagon like peptide 1 (GLP-1 7-36) (Study 2 and 3 only), cholecystokinin-8, subjective appetite ratings (visual analogue scales) and *ad libitum* energy intake.

Results – *Ad libitum* energy intake was approximately 10% higher 3h after ingestion of glucose preloads relative to protein-based treatments, although this was not observed at 4h. Protein ingestion was consistently associated with prolonged elevation of plasma cholecystokinin and GLP-1 for 120 min relative to glucose, independent of the protein type. Similarly, dietary proteins were associated with prolonged suppression of ghrelin that persisted 4h after preload consumption. The contrasting ghrelin profile after glucose consumption with an increase above fasting concentration at 3-4h coincided with a decrease in glucose below baseline, increased hunger ratings (Study 1) and higher *ad libitum* food intake. Replacing some whey with fructose attenuated the effect of protein on these gut hormones. The effects of treatment on energy intake and appetite hormones were independent of body weight status, despite overall higher GLP-1 and lower ghrelin concentrations in overweight/obese subjects.

Conclusion – Liquid preloads rich in dietary proteins reduce *ad libitum* intake over 3h in overweight and obese subjects, relative to carbohydrate. This may be partly attributed to the ‘satiating’ profile of gut hormones (prolonged suppression of ghrelin and elevation of GLP-1 and cholecystokinin) that is independent of protein source and body weight status and which may relate to the amount of protein consumed.