

Dairy Protein, Appetite, Satiety and Weight Loss

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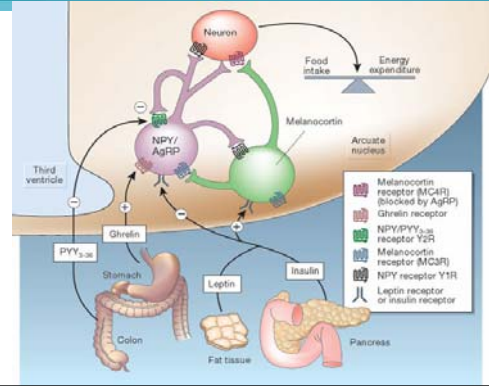
Endogenous factors influencing food intake

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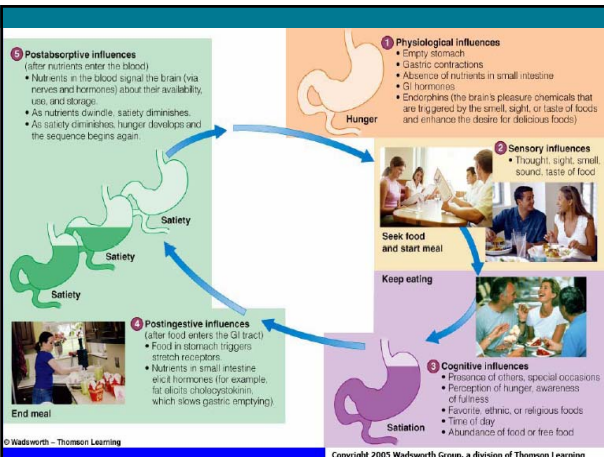
- **Appetite/hunger**
the desire to eat
- **Satiation**
the signal to bring eating to an end
- **Satiety**
the suppression of appetite/hunger



- | | |
|---|----------|
| Appetite/hunger the desire to eat- | high |
| Satiation the signal to bring eating to an end- | low |
| Satiety the suppression of appetite/hunger | very low |



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Why More Protein?

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- ☉ enhances weight loss (Skov et al. 1999; Baba et al. 1999)
- ☉ promotes favourable changes in body composition (Skov et al. 1999; Laymen et al. 2003; Parker et al. 2002)
- ☉ beneficial effects on heart disease risk factors
 - insulin sensitivity (Baba et al. 1999; Laymen et al. 2003; Piatti et al. 1994)
 - glucose/insulin profiles (Farnsworth et al. 2003; Gannon et al. 2003)
 - triglyceride reduction (Laymen, 2003; Farnsworth 2003; Gannon 2003)



Is it Protein Type or Lower Carb or Calcium?

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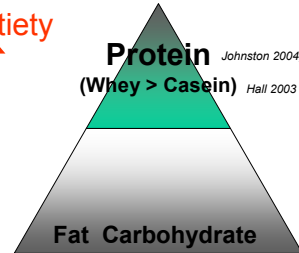
- enhances weight loss
? protein/carb/calcium
- promotes favourable changes in body composition
? protein/carb/calcium
- beneficial effects on heart disease risk factors
 - insulin sensitivity ? protein/calcium
 - glucose/insulin profiles ✓ lower carb
 - triglyceride reduction ✓ lower carb



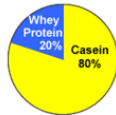
Protein Type - Influence on Satiety

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Satiety



Composition of Milk Protein



Leucine and BCAA content of foods¹

| | Leucine | BCAA |
|----------------------|---------|------|
| Whey protein isolate | 14% | 26% |
| Milk protein | 10% | 21% |
| Egg protein | 8.5% | 20% |
| Muscle protein | 8% | 18% |
| Soy protein isolate | 8% | 18% |
| Wheat protein | 7% | 15% |



Protein Digestion

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- Casein
 - Coagulated by gastric acid
 - Slow gastric emptying
 - Hydrolysed BEFORE entering small intestine
- Whey
 - Soluble
 - Rapid gastric
 - Intact protein enters small intestine

Calbet 2004, Boirie 1997



Whey Proteins

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Whey proteins are not a single protein but consist of a number of individual protein components.

- Beta-Lactoglobulin
- Glycomacropeptide (GMP)
- Alpha-lactalbumin
- Lactoferrin
- Immunoglobulins
- Lactoperoxidase
- Bovine Serum Albumin (BSA)
- Lysozyme



Whey Protein and Weight Gain –animal studies

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- J Nutr. 2004 Jun;134(6):
A high-whey-protein diet reduces body weight gain and alters insulin sensitivity relative to red meat in wistar rats.
Belobrajdic DP, McIntosh GH, Owens JA.
 - Rats were fed a high-fat diet (300 g fat/kg diet) for 9 wk, then switched to a diet containing either 80 or 320 g protein/kg diet, provided by either Whey Protein Concentrate or Meat, for 6 wk (n = 8).
 - High dietary protein reduced energy intake (P < 0.001) and visceral (P < 0.001), subcutaneous (P < 0.001), and carcass fat (P < 0.05).
 - Increasing Whey reduced body weight gain by 4% (P < 0.001).
 - Dietary WPC also reduced plasma insulin concentration by 40% (P < 0.05) and increased insulin sensitivity, compared to RM (P < 0.05).





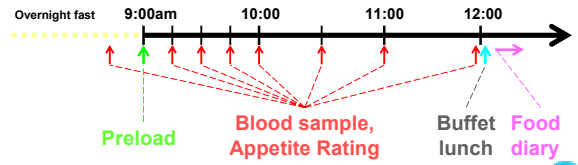
National Centre of Excellence in Functional Foods

To investigate the effect of **whey & casein** (relative to carbohydrates) on appetite, gastric emptying & postprandial hormones in overweight men.



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19 obese men (Age: 53 ± 2y, BMI: 32 ± 1kg/m²)
Fasting glucose: 6.3 ± 0.1mmol/L



Approved by the CSIRO Division of Health Sciences and Nutrition Human Ethics Committee.



Liquid Preloads



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- 1000 kJ
- <1g fat

50g Protein OR

50g Carbohydrate



- Whey protein isolate
- Calcium caseinate



- Lactose (low glycemic index*)
- Glucose (high glycemic index*)

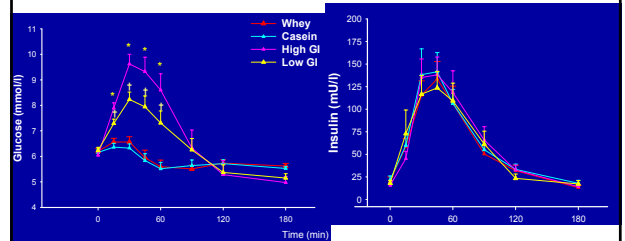
*Glycemic Index –rate of post prandial increase in plasma glucose

High GI: greater increase in plasma glucose (?lower satiety)

Low GI: lower rise in plasma glucose (?higher satiety)



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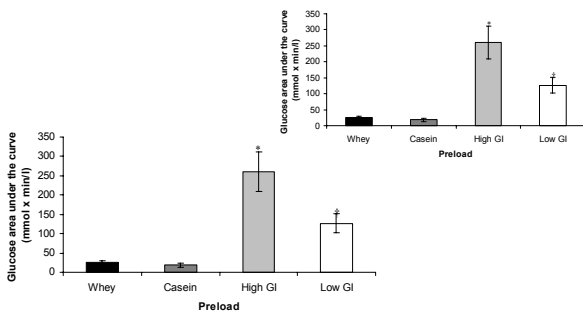


* > whey, casein, low GI P < 0.01

† < high GI, P < 0.01



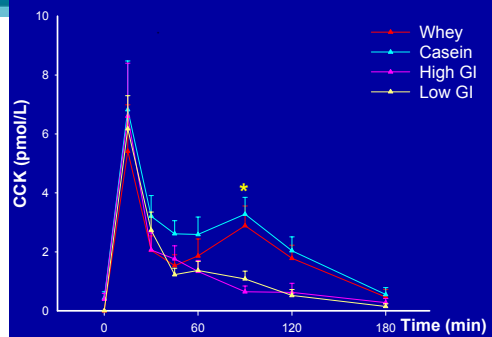
Casein v Whey? Effect on glucose/insulin



Cholecystokinin



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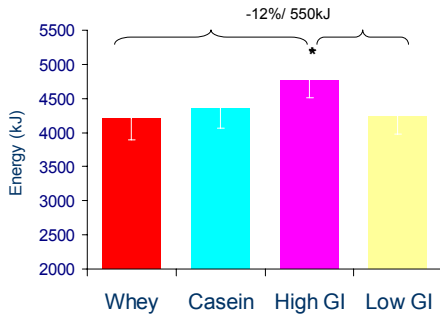


* > high GI and low GI, P < 0.01

Time x preload effect between protein & carb, P < 0.05



Buffet Energy Intake

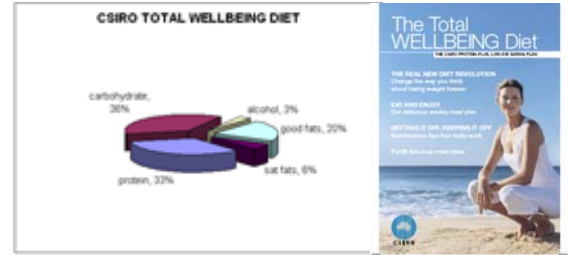


* > whey and low GI, p < 0.05



High protein high calcium dietary patterns and weight loss

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~110g protein

~35g fat

~160g carbohydrate



Key Foods on Higher Protein Pattern

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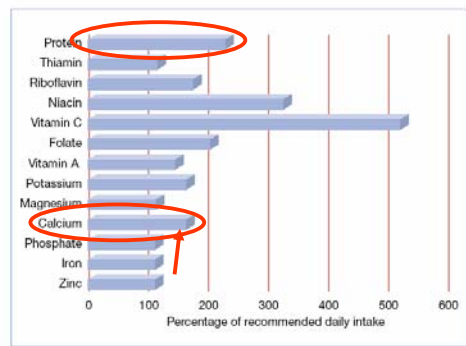
~5500-6000KJ for basic plan

- DAIRY FOODS, 2-3 serves per day
- MEAT/CHICKEN/FISH 200g/day at dinner
 - Red meat 4X/week
 - Fish 2X/week
 - Chicken or other lean meat 1X/week
- CHICKEN/FISH/MEAT/EGGS 50-100g/day at lunch
- WHOLEGRAIN BREAD, 2 slices per day
- HIGH-FIBRE CEREAL, 1 serve per day
- FRESH FRUIT, 2 serves per day
- VEGETABLES, 2.5 cups (see list)
- FAT AND OIL, 3 teaspoons per day
- WINE 300ml per week (optional)



Better Nutritional Profile on Higher Protein

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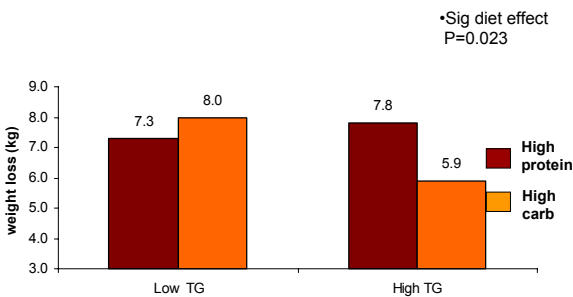


Nutrient density of a typical higher protein weight reducing diet (based on CSIRO study 12)



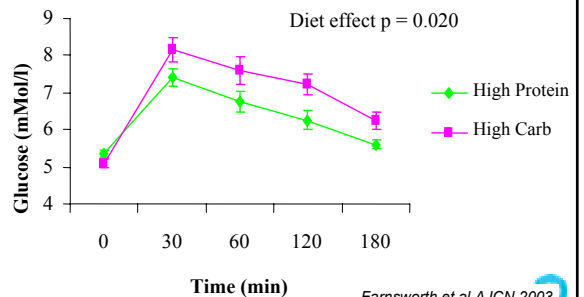
Greater Weight Loss on Higher Protein depending on Triglyceride Status

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Effects of High Protein Meals in Subjects With High Insulin

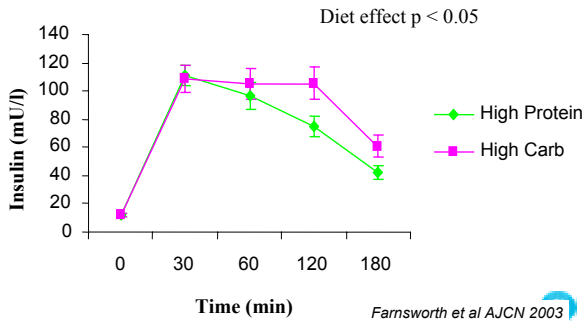
Glucose Response to Test Meals



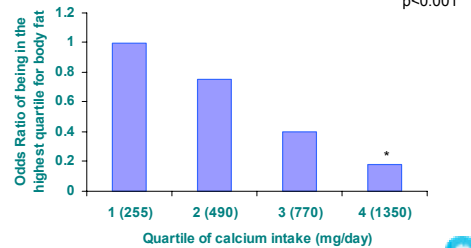
Farnsworth et al AJCN 2003



Insulin Response to Test Meals



Dairy/calcium intake predicts risk of being in the highest quartile of body fat for women in NHANESIII



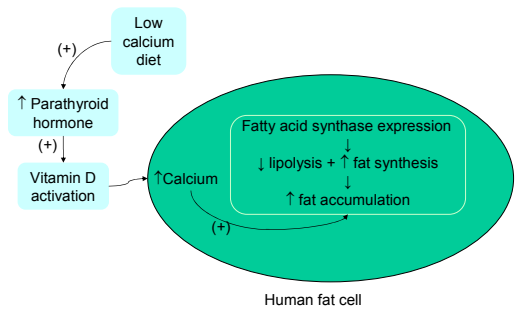
Dairy food, calcium & weight

Intervention studies: calcium supplementation

- Meta-analysis of 5 Studies (Davies et al 2000)
 - Skeletal end points in 780 women
 - Inverse association with calcium intake & body weight.
 - Odds ratio of 2.25 for being overweight & in the below median calcium intake compared to those above the median.
- Not consistently observed (Whelton et al 1997).



Calcium and body weight: a proposed mechanism



Dairy food, calcium & weight

- Intervention study (Zemel et al 2002)
 - n= 41 obese subjects
 - 24 weeks on energy restricted diets:
 - 3.5 serves dairy (1200mg Ca),
 - Ca supplementation (800 mg Ca)
 - Low calcium (500mg Ca)
- Subjects on high dairy intake
 - Greater loss of
 - total weight; 11% vs 5%
 - fat mass 14% vs 8%



Does Protein Source Matter?

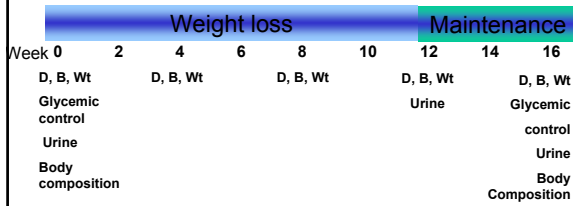
Aim: To compare the effect of a high dairy protein diet with a high mixed protein diet, on body composition, glycemic control, plasma lipids and bone turnover in overweight adults.

Bowen et al J Nutr 2004



Study design

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D, B, Wt = Diet check, Blood Sample (Fasting), Weight
Bowen et al J Nutr 2004



Diet: Macronutrient Composition

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- 5500kJ/day
- 35% energy from protein (113g/day)
- 24% energy from fat (36g/day)
- 41% energy from carbohydrate (140g/day)
- Dairy Protein diet: 2400mg Ca/day
- Mixed Protein diet: 460mgCa/day

Bowen et al J Nutr 2004



Diet: Foods Prescribed

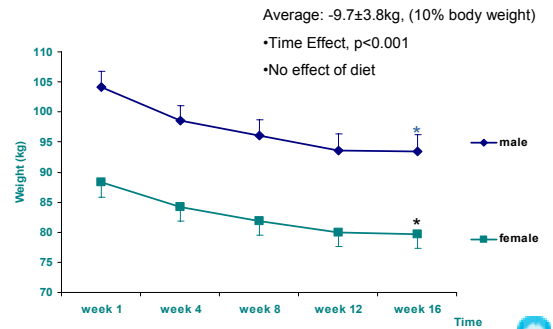
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| | Dairy Protein | Mixed Protein |
|-------------|--|---------------------------------|
| Bread | 2 slices | 3 slices |
| Milk (skim) | 500ml | 125ml |
| Fruit | 1 | 2 |
| Oil | 15g | 10g |
| Meat/fish | 100g | 350g |
| Vegetables | 2.5c | 2.5c |
| Biscuits | 2 Vita Weat | 2 Fruit (low fat) |
| Eggs | 2/week | 4/week |
| Other | 40 g low fat cheese 30 g Cheddar cheese 50g Skim Milk Powder 200g low fat yoghurt | 10 almonds 400g legumes/week |



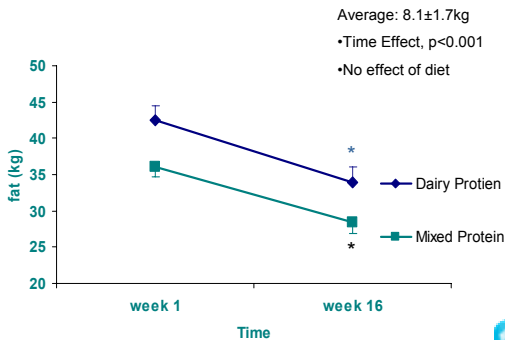
Total Weight loss

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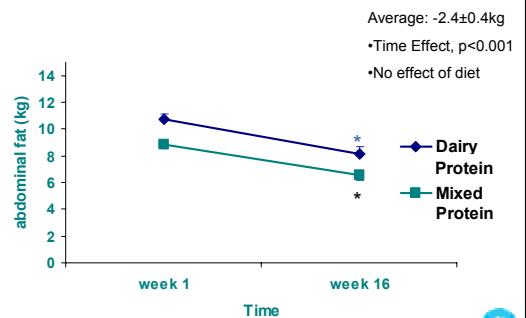
Total Fat Loss

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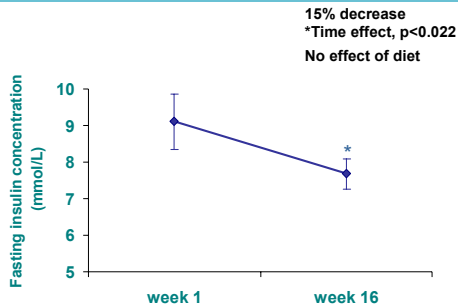
Abdominal Fat Loss

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Fasting Insulin

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No change in fasting glucose concentration.



Glycemic Control- MTT & OGTT

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Fasting blood sample
Consume meal
Blood at ½ 1, 2, 3 hours after meal.

| Dairy Meal | Mixed protein meal |
|----------------|--------------------|
| Bread 2 slices | Bread 2 slices |
| Margarine 10g | Ham 60g |
| Cheese 40g | Egg 1 |
| Yoghurt 200g | Biscuit 2 bisc |

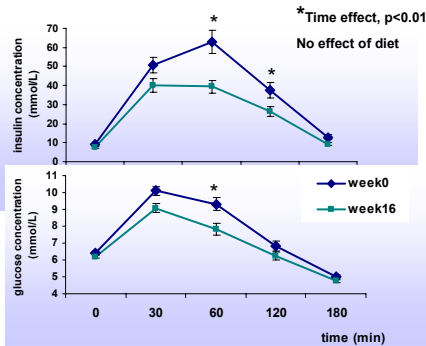


Oral Glucose Tolerance Test

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33% decrease in Area Under the Insulin Curve, $p < 0.0001$

30% decrease in Area Under the Glucose Curve, $p < 0.02$

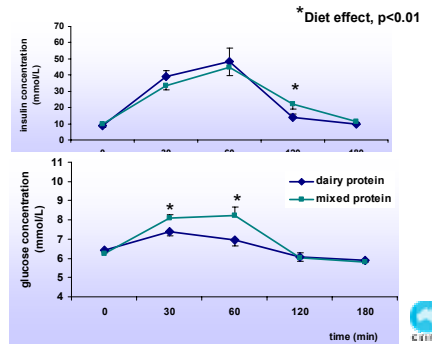


Meal Tolerance Test – Week 0

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Dairy Protein Meal
Lower insulin concentration at 120 min, $p < 0.05$

Dairy Protein Meal
2 fold lower Area Under the Glucose Curve, $p < 0.02$



Summary

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- 10% weight loss, independent of protein source
- Males lost more lean mass than females
- Similar to previous studies of HP diets (Parker et al 2002, Luscombe et al 2002)
- Does not support hypothesis that dietary calcium enhances weight loss.
- Previous study: (Zemel 2002)
 - Longer period of energy restriction (24 vs 12 wk)
 - Lower calcium (1200mg vs 2400 mg)
 - Smaller sample size (41 vs 50)
 - ? Vitamin D



Final Conclusions

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- High protein lower carbohydrate diets are an effective dietary approach for achieving weight loss.
- Effects of protein source and the role of calcium need further investigation re other components and generalisability
- High protein high dairy dietary patterns for weight loss are preferred option due to nutritional adequacy and low glycaemic load as well as protein benefits on satiety



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