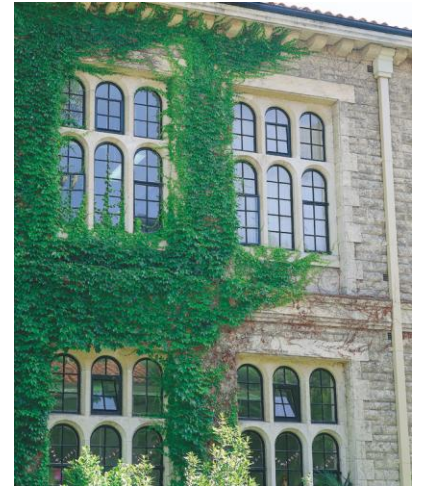
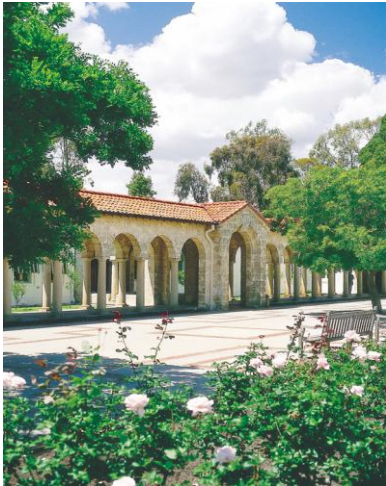




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# Legumes – good for the pulse



# What are legumes?



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- A **legume** is a plant in the family *Leguminosae*
- Legumes can fix atmospheric nitrogen due to a symbiotic relationship with bacteria (rhizobia) found in root nodules
- The ability to fix nitrogen reduces fertilizer costs when the legume is grown in crop rotations
- Therefore legumes are a vital part of **sustainable food production**, particularly where soils have low nitrogen

# What are pulses?



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- Farmed legumes can belong to many agricultural classes: not all legumes are food
- **Grain legumes** are cultivated for their seeds. They are also called **pulses**.
- Pulses are used for food and feed
- Pulses include chick peas, beans, lentils, peas, peanuts and **lupins**.



# Pulses and health: background



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- A major focus of the Australian Dietary Guidelines is to increase the intake of plant-derived foods
- These guidelines also highlight the potential health benefits of legumes (pulses)



# Pulses and health: summary of healthy attributes



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- Excellent source of **protein**: 15-25%
- Good source of **low GI carbohydrate**: 30-45%
- Rich in **dietary fibre**, including soluble fibre and resistant starch
- Often a good source of **nutrients and phytochemicals** thought to provide health benefits: potassium; carotenoids; flavonoids

# Pulses and health: the evidence



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- **Population studies** show that dietary patterns which include pulses are associated with reduced risk of cardiovascular disease
- **Intervention studies** have demonstrated benefits of specific pulses on risk factors for cardiovascular disease



# Population pulse intakes



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- Despite evidence for health benefits of pulses, intakes remain low in Australian

## Why are intakes low?

- Food culture
- Lack of knowledge

## Solution

- Develop novel pulse-derived ingredients which can be incorporated into commonly consumed “staple” foods: *e.g. soy protein*

**Lupin flour is an example of such an ingredient**



**Lupin grain**



# Lupin grain with seed coat removed



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# Lupin enriched foods



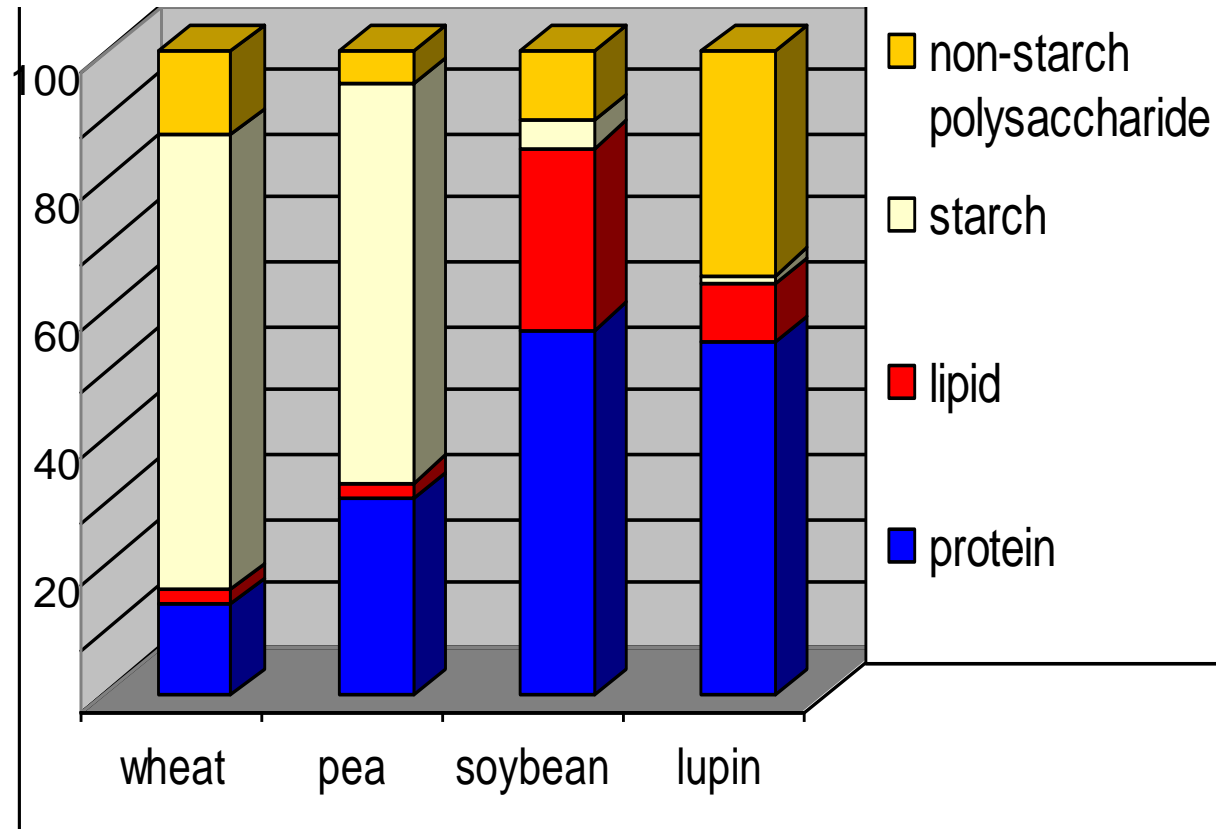
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# Why lupin flour?



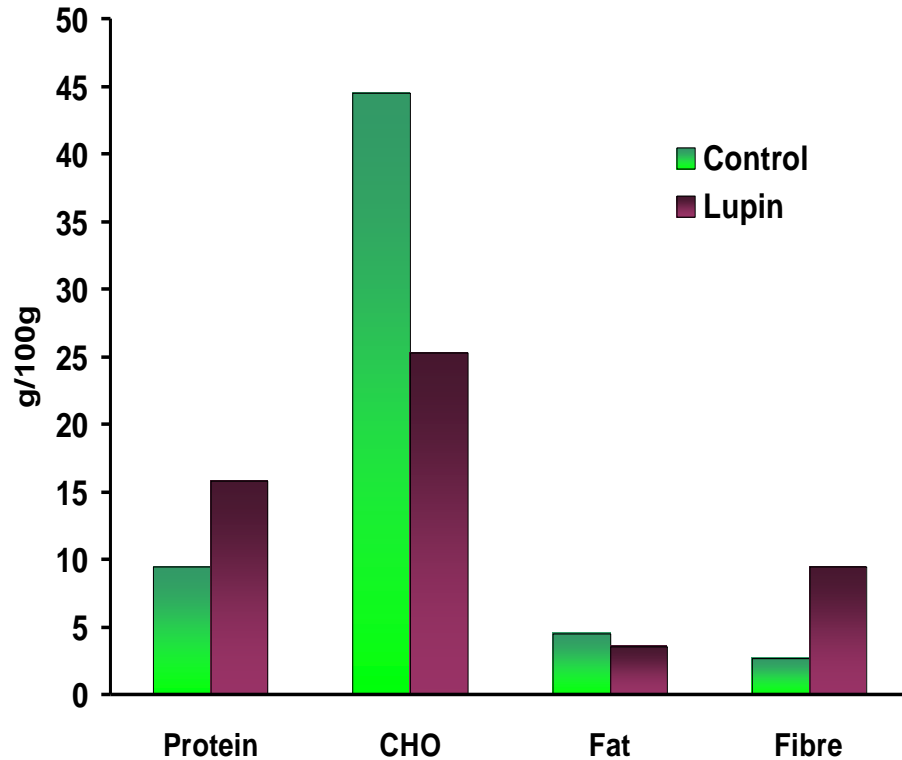
45% protein  
30% dietary fibre  
negligible starch



# Lupin enriched bread



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|                        | White bread | Lupin bread |
|------------------------|-------------|-------------|
| Energy (kJ)            | 1400        | 1400        |
| Bread weight (g)       | 126         | 158         |
| Total moisture (g)     | 46          | 68          |
| Total fat (g)          | 5.7         | 5.7         |
| Total protein (g)      | 12          | 25          |
| Total ash (g)          | 2.1         | 3.3         |
| Total fiber (g)        | 3.4         | 15          |
| Total carbohydrate (g) | 57          | 40          |

# Why replace refined carbohydrate with protein and fibre?



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- Refined and modified carbohydrates may contribute to increased risk of obesity, type 2 diabetes and CVD
- Plant protein and dietary fibre may help to reduce the risk of obesity, diabetes and CVD



# Appetite / obesity



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- Protein is the most satiating nutrient
- Protein compared to carbohydrate results in reduced appetite acutely
- Fibre-rich diets can also reduce appetite acutely
- Some evidence for longer-term benefits of protein or fibre-rich diets in weight management

# Type 2 diabetes



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- Partial replacement of refined carbohydrate in foods with protein and or fibre can reduce **glucose and insulin** response / reduce the **GI** / this may assist in the management of type 2 diabetes
- Higher fibre diets have been associated with reduced risk of **type 2 diabetes**
- Effects of higher protein diets on risk of **type 2 diabetes** are not clear



# Blood pressure and cholesterol

- Dietary protein and dietary fibre have independent and additive effects to lower **blood pressure** in humans
- Increases in plant protein and fibre may also lower **blood cholesterol** concentrations

# 1. Acute effects on appetite in healthy individuals

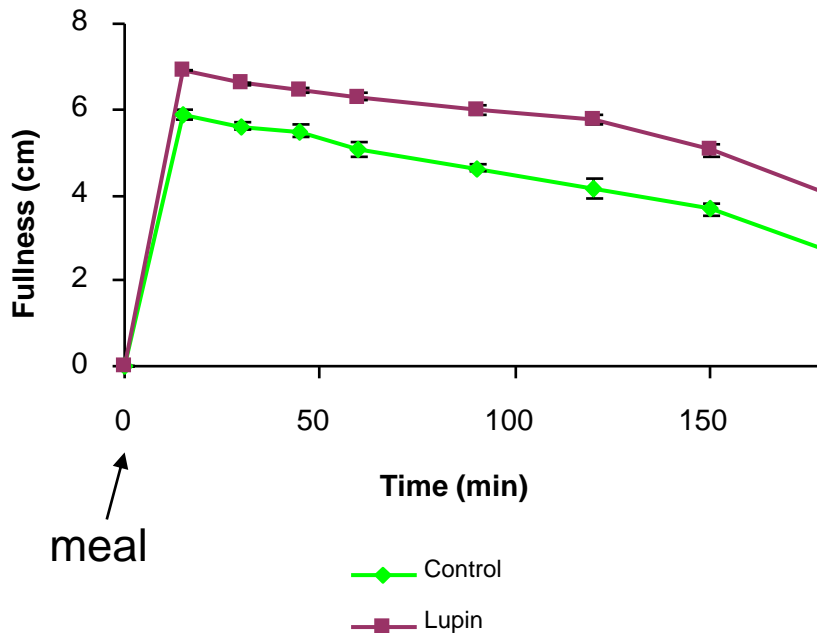


Self reported appetite was reduced by lupin bread :

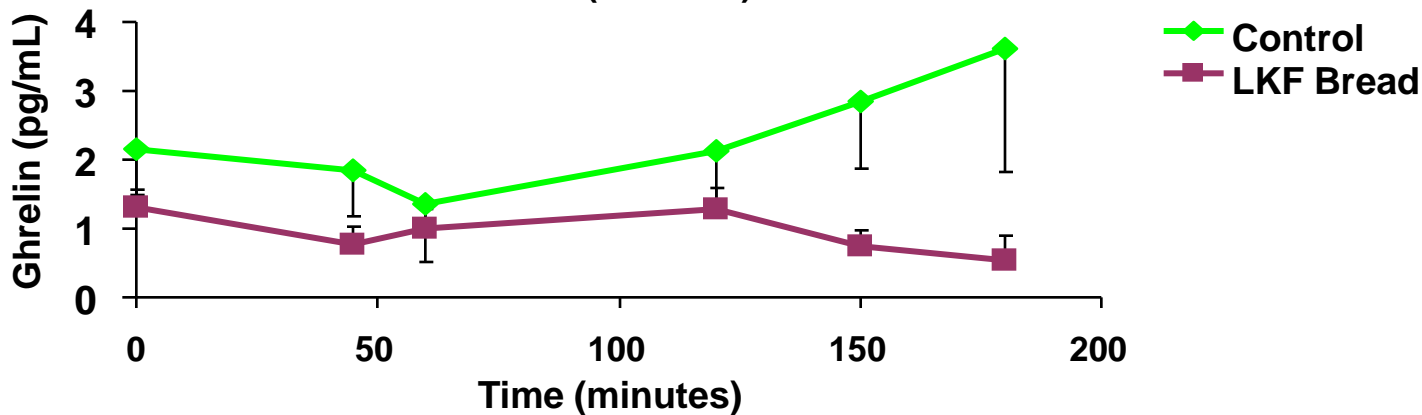
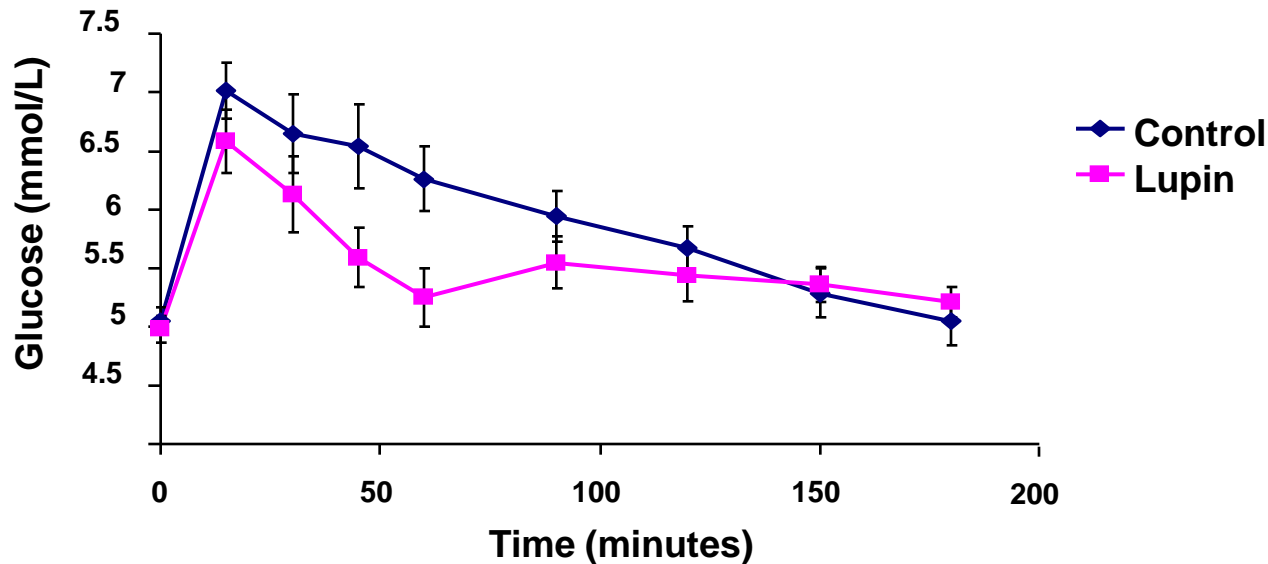
- fullness
- hunger

Energy intake was reduced by lupin bread:

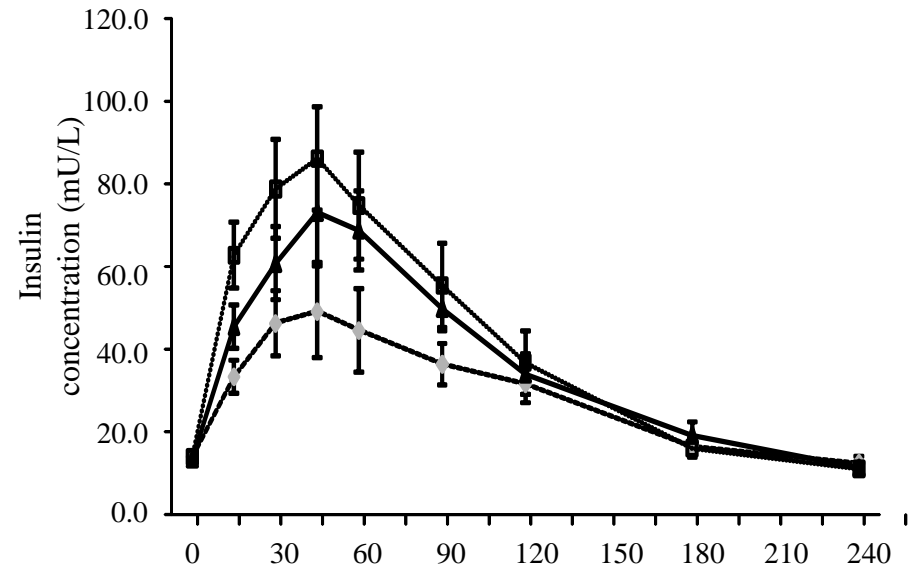
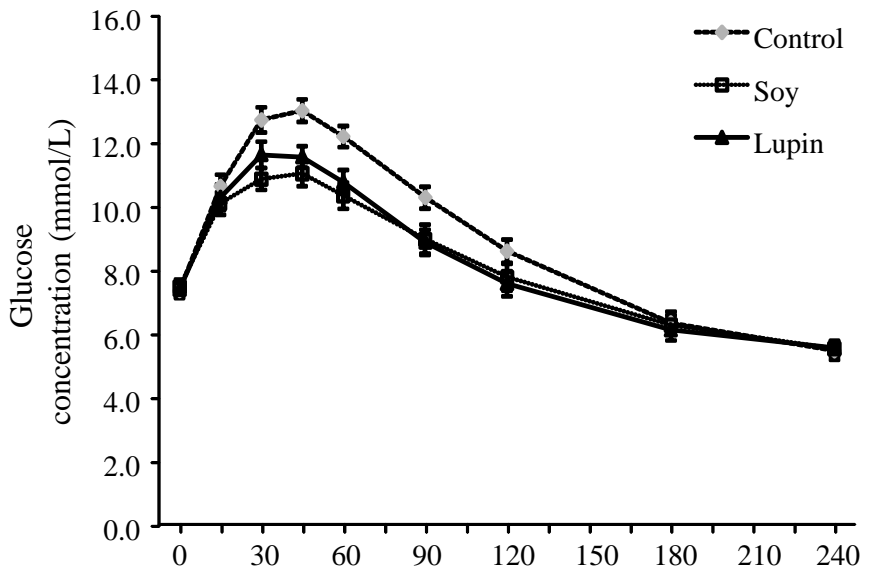
- 25% within a meal
- 15% at the next meal



## 2. Acute effects on glucose/insulin and ghrelin in healthy individuals



### 3. Acute effects on glucose/insulin in type 2 diabetic subjects



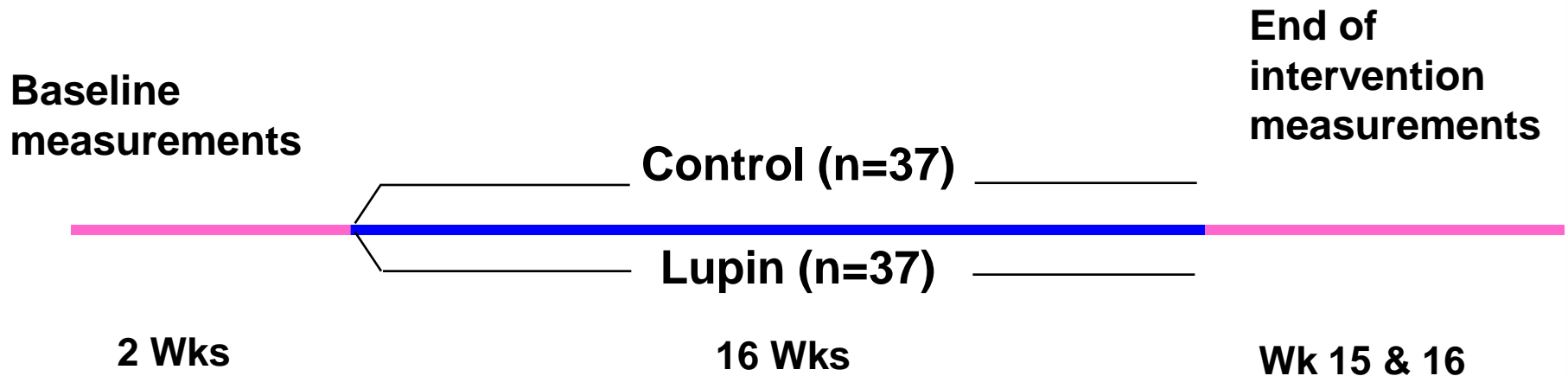
Dove ER, Mori TA, Chew GT, Barden AE, Woodman RJ, Puddey IB, Sipsas S, Hodgson JM. Lupin and soy reduce glycemia acutely in type 2 diabetes. *Br J Nutr* 2011; doi:10.1017/S00007114511001334.

## 4. Effects of regular consumption body composition and CVD risk factors: an *ad libitum* diet in overweight individuals



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- A 4 month (16 wks) randomised controlled parallel-designed trial
- Overweight (BMI >25 kg/m<sup>2</sup>), but otherwise healthy volunteers
- 74 participants (26 men, 48 women)

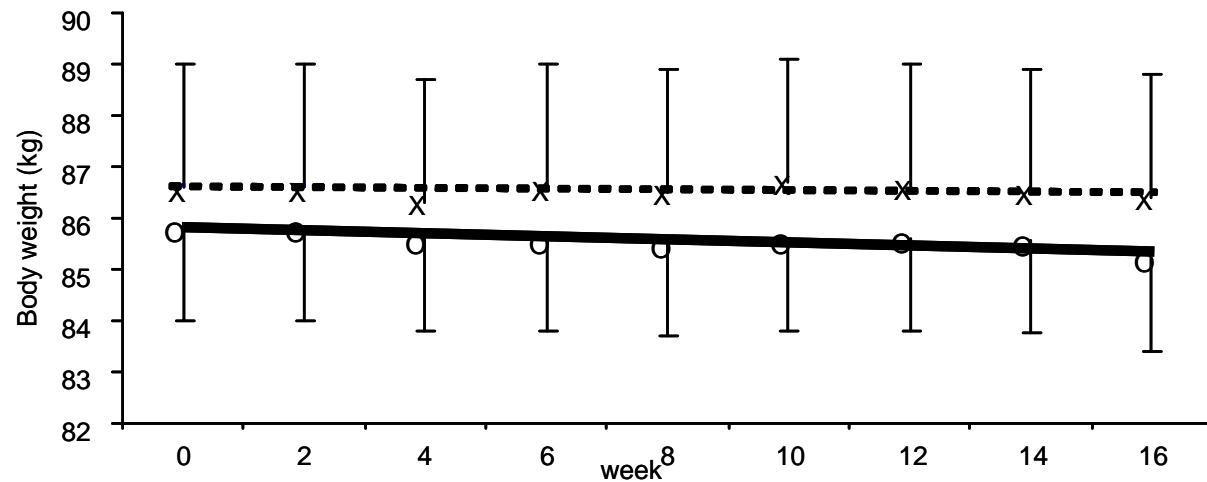


## 4. Effects of regular consumption body composition and CVD risk factors: an ad libitum diet in overweight individuals



Body weight and  
composition

X-Control  
O-Lupin



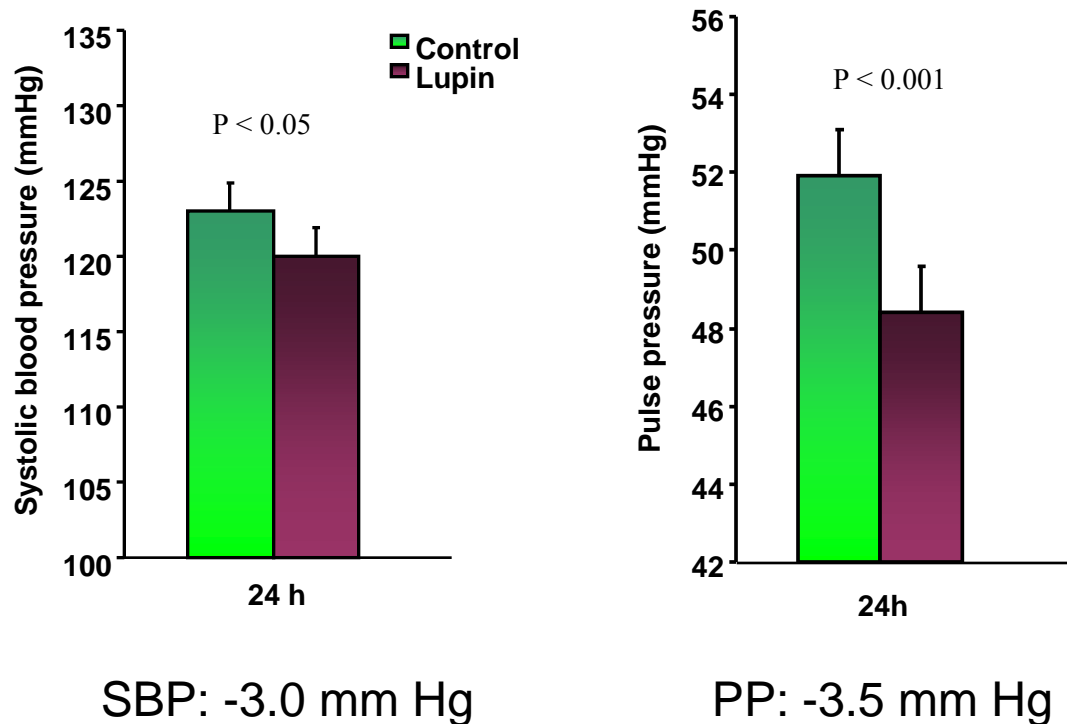
### Between-group differences

- Body weight: -0.4 kg (P=0.45)
- Body fat mass: -0.5 kg (P=0.20)
- Body fat percent: -0.5% (P=0.14)

## 4. Effects of regular consumption body composition and CVD risk factors: an ad libitum diet in overweight individuals



### Blood pressure

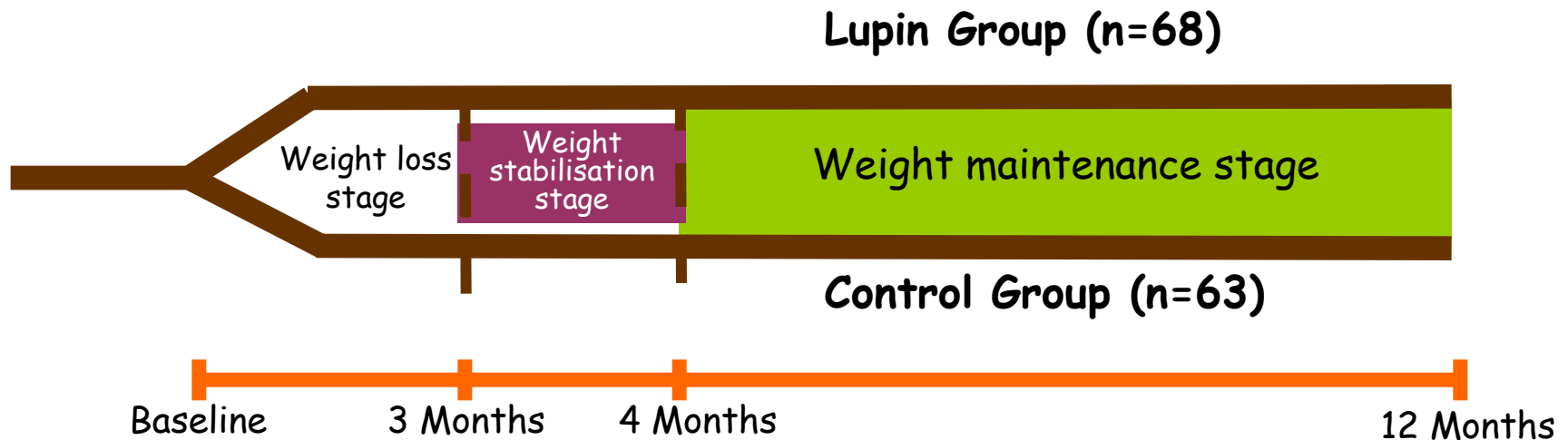


At a population level these effects would translate to a 10% lower risk of hypertension and stroke

## 5. Effects of regular consumption on weight loss and CVD risk factors in overweight individuals

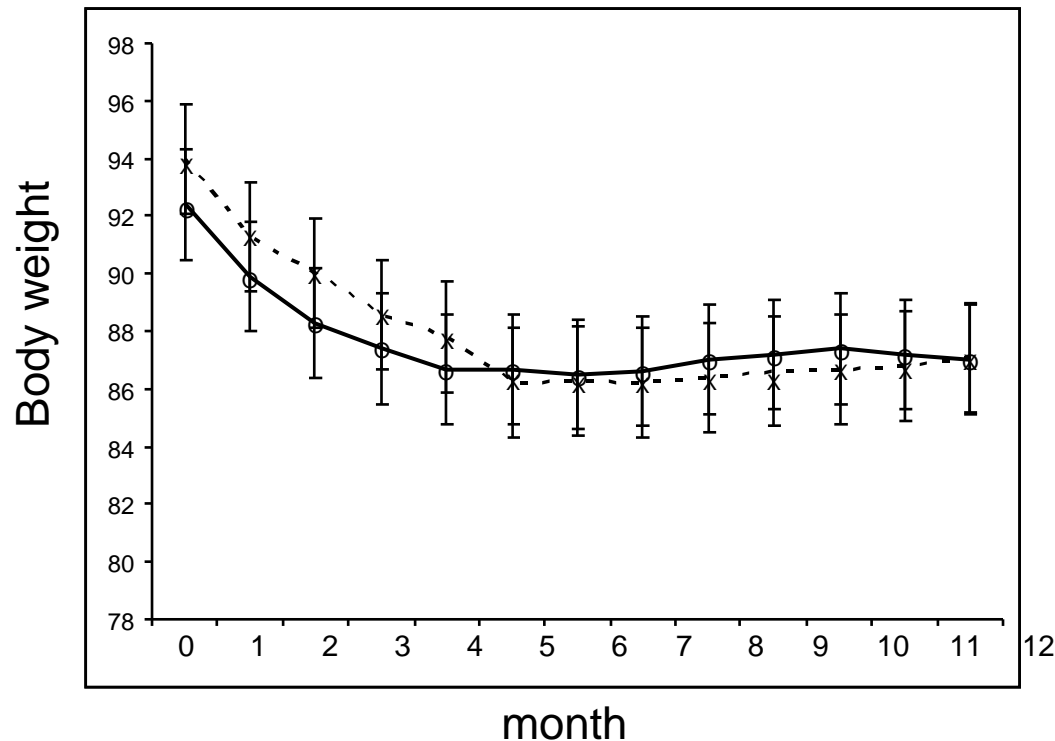


- A 12 month randomised controlled parallel-designed trial
- Overweight (BMI >27 kg/m<sup>2</sup>), but otherwise healthy volunteers
- 131 participants (68 men, 63 women)



# 5. Effects of regular consumption on weight loss and CVD risk factors in overweight individuals

Body weight



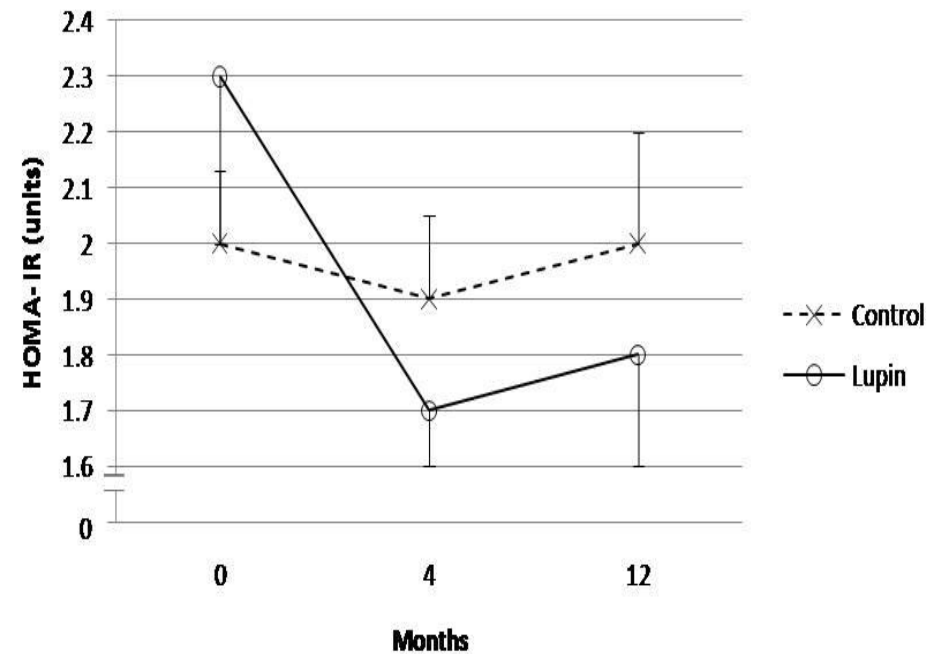
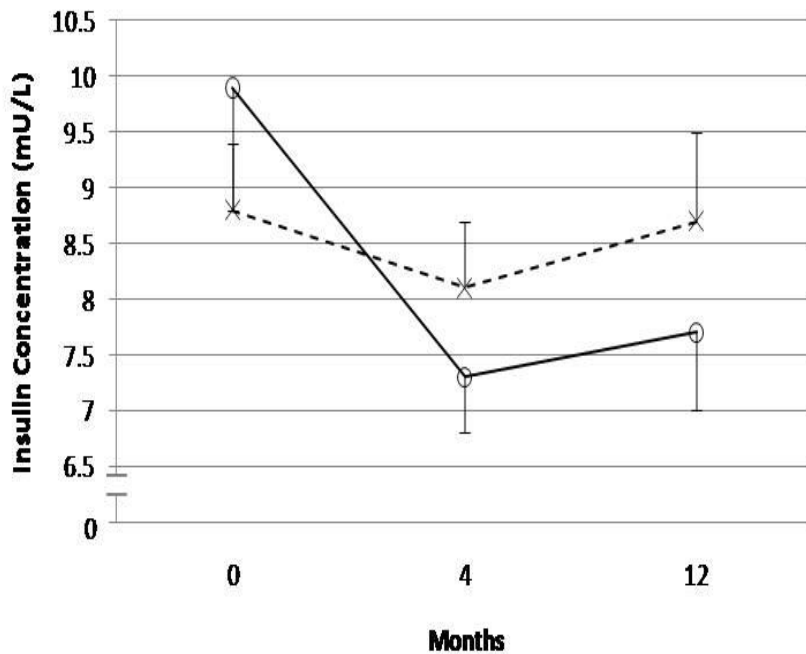
X-Control  
O-Lupin

Blood pressure SBP: -1.3 mm Hg; DBP: -1.0 mm Hg

Belski R, Mori TA, Puddey IB, Sipsas S, Woodman RJ, Ackland TR, Beilin LJ, Dove ER, Carlyon NB, Jayaseena V, Hodgson JM. Effects of lupin-enriched foods on body composition and cardiovascular disease risk factors: a 12 month randomised controlled weight loss trial. *Int J Obes* 2010; 35:810-9

# 5. Effects of regular consumption on weight loss and CVD risk factors in overweight individuals

## Insulin sensitivity



Belski R, Mori TA, Puddey IB, Sipsas S, Woodman RJ, Ackland TR, Beilin LJ, Dove ER, Carlyon NB, Jayaseena V, Hodgson JM. Effects of lupin-enriched foods on body composition and cardiovascular disease risk factors: a 12 month randomised controlled weight loss trial. *Int J Obes* 2010; 35:810-9

# Conclusions



- Grain legumes (pulses) provide a important contribution to sustainable agriculture
- Pulse consumption is likely to contribute significantly to human health
- Lupin flour is a novel food ingredient which can be incorporated into high carbohydrate foods to increase protein and fibre content
- Studies indicate benefits of lupin-enriched foods on appetite, blood pressure, glycemic control and insulin sensitivity

# Future directions



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- Additional work is needed to:
  - (1) establish these benefits
  - (2) generate a wide variety of commercially viable food choices
- Similar approaches could be used to increase the intake of other pulses (chickpea / lentils / beans)

# Acknowledgements



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