ROLE OF PLANT STEROLS AND STANOLS IN A CHOLESTEROL LOWERING DIET

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OUTLINE

- What are plant sterols/stanols?
- Mechanism of action
- What is the evidence for plant sterols/stanols in cholesterol lowering?
- An additive cholesterol lowering effect to lipid-lowering medication
- The ‘Portfolio diet’
- Dietary guidelines

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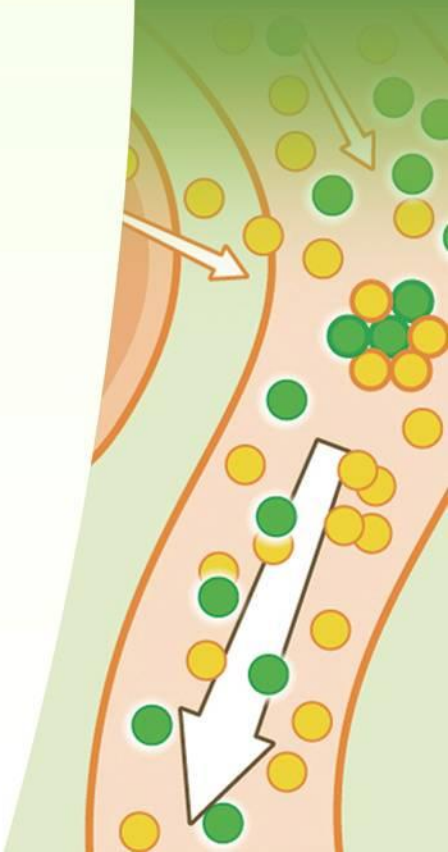

LDL-cholesterol lowering

Component	Dose or change in intake/habit	Approximate LDL-cholesterol reduction	Recommendation in case of elevated LDL-cholesterol/increased CVD risk
Saturated fatty acids (reduction in intake)	- 5% of total energy intake	-5%**	Reduce intake to ‹7% of total energy
Body weight (loss) ***	- 5kg	-5%	Lose approx. 10% body weight***
Plant sterols	Approx. 2g/day	-10% ****	Consume 2g/day
Viscous dietary fibre	5-10g/day	-5%	Increase intake to 10g/day
Soya protein	25-50g/day	Up to 6%	Consume at least 25g/day
Polyunsaturated fatty acids	+ 5% of total energy intake	-3%*****	Consume up to 10% of total energy

** typically low in saturated fatty acids, high in fruit and vegetables and low in salt ** calculated assuming a baseline LDL-cholesterol level of 3.5 mmol/l and assuming that 5% energy from saturated fatty acids are replaced by an isocaloric amount of carbohydrates[1] *** where overweight/obese **** Katan et al. Mayo Clin Proc 2003[2] ***** calculated assuming a baseline LDL-cholesterol level of 3.5 mmol/l and assuming that 5% energy from carbohydrates are replaced by an isocaloric amount of polyunsaturated fatty acids[1]*

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Plant sterols are natural components of the human diet

Major sources of plant sterols:

- fat and oils
- bread and cereals
- fruits and vegetables
- nuts

Average daily plant sterol intake of adults
150 - 400mg/day

Recommended intake of plant sterol-enriched foods for a significant cholesterol-lowering effect
2g/day*

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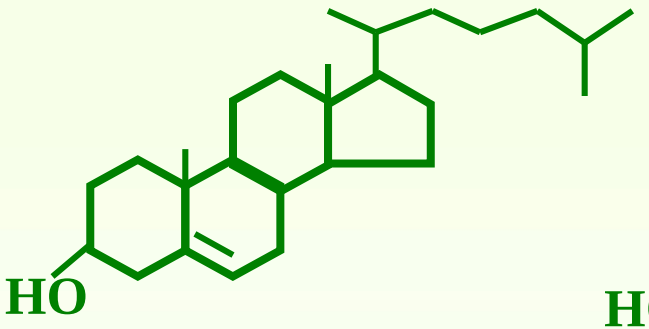
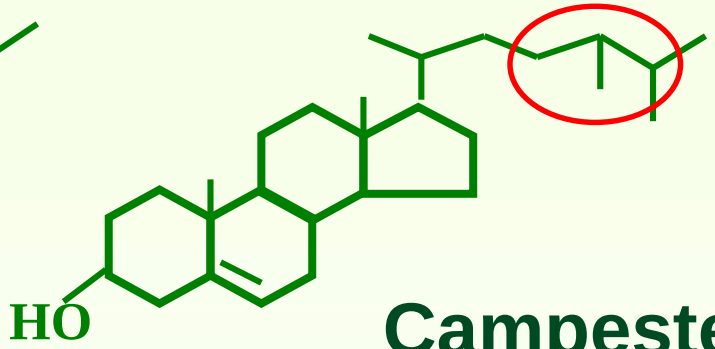
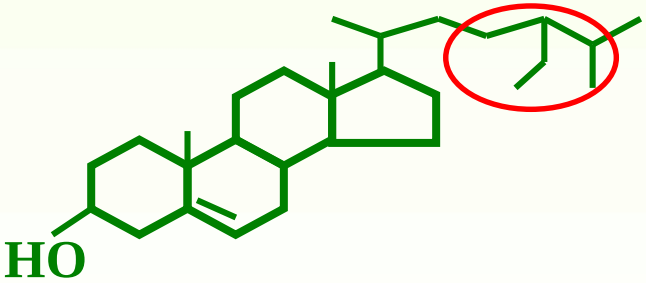
Plant sterols and stanols have similar structures to cholesterol



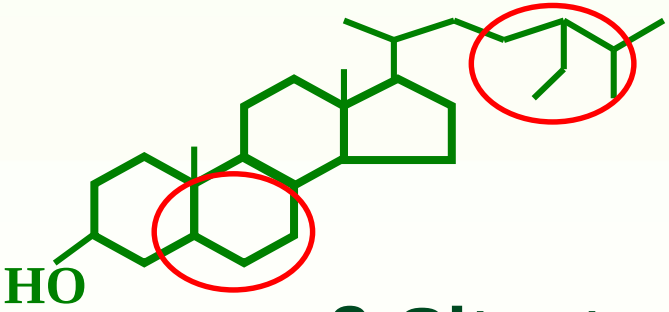
Cholesterol



Campesterol

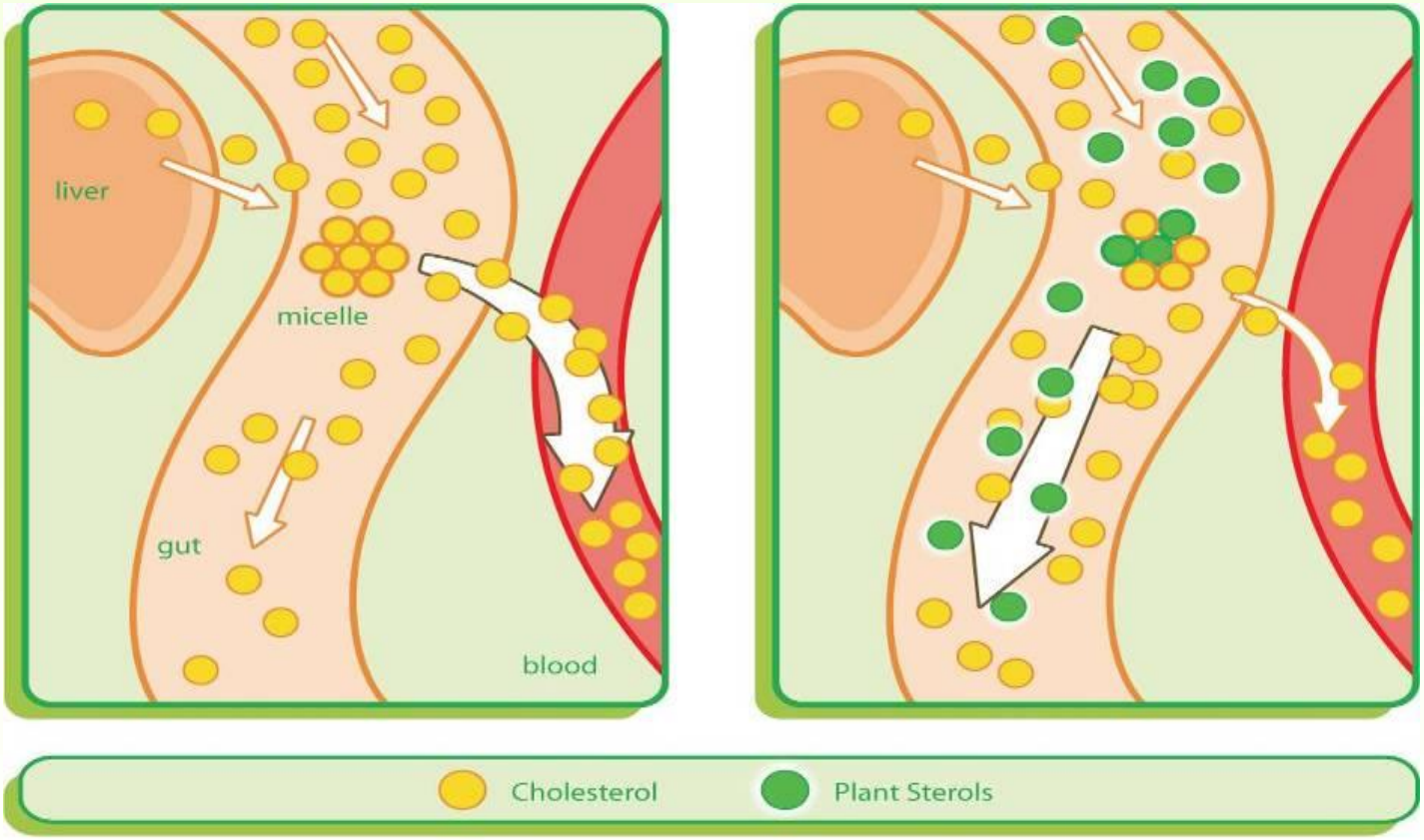


ß-Sitosterol



ß-Sitostanol

Plant sterols and cholesterol absorption



More cholesterol absorbed =

Higher blood cholesterol levels

Less cholesterol absorbed =

Lower blood cholesterol levels

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Clinical studies performed

- Cholesterol-lowering effects of plant sterols have been known since the early 1950s
- Over **170** studies have been carried out on plant sterols
- Subjects involved in the studies included:
  - Healthy adults and those with hypercholesterolaemia (men and women)
  - Those on normal Western diets and those on low-fat diets
  - Those with increased risk: diabetes, familial hypercholesterolaemia
  - Children: familial hypercholesterolaemia.

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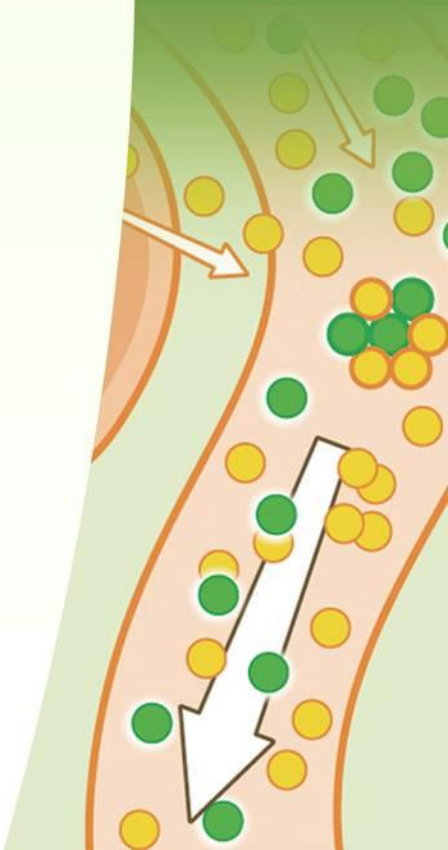
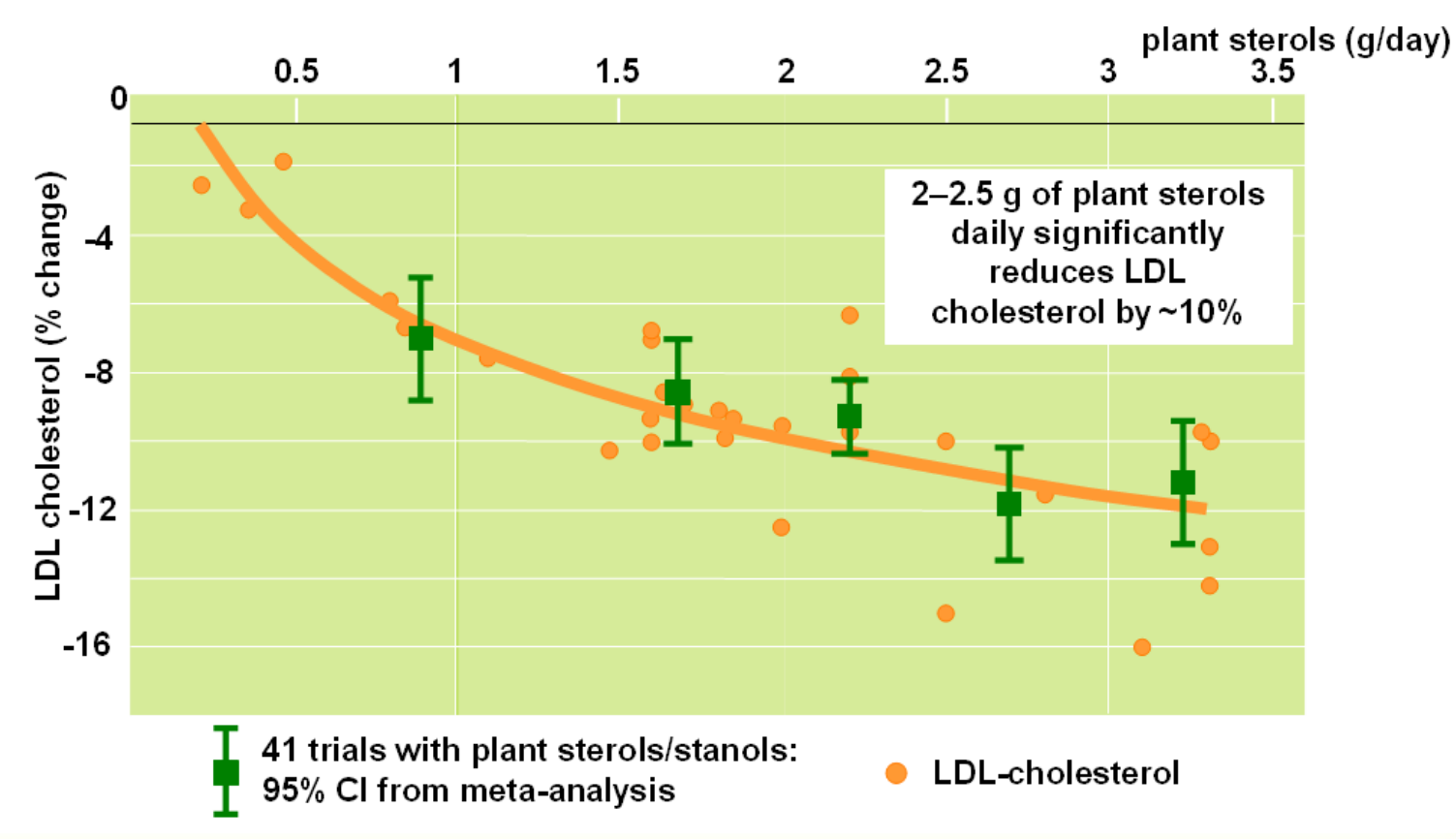
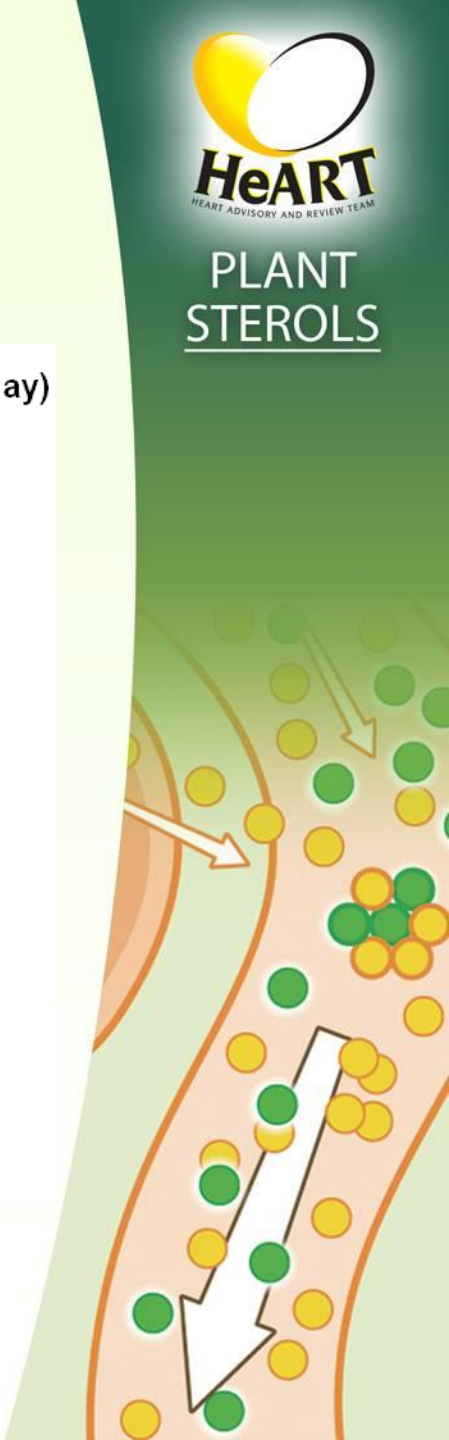


Overview of clinical trials assessing efficacy of plant sterols





Quantity of regular foods required to provide 2g plant sterols

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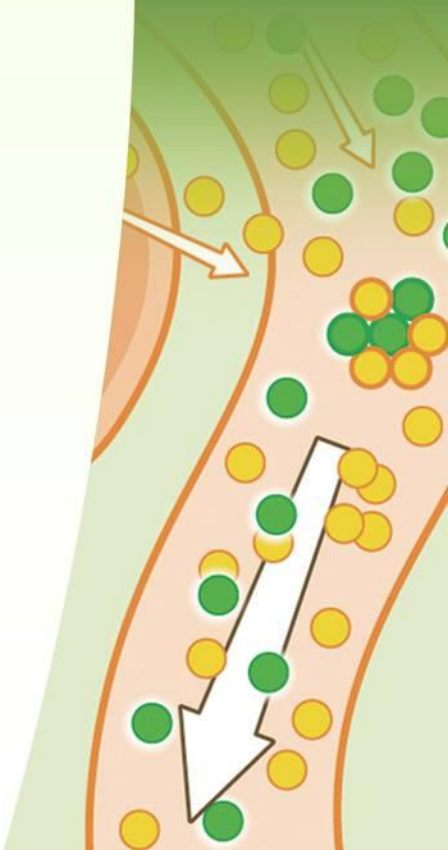
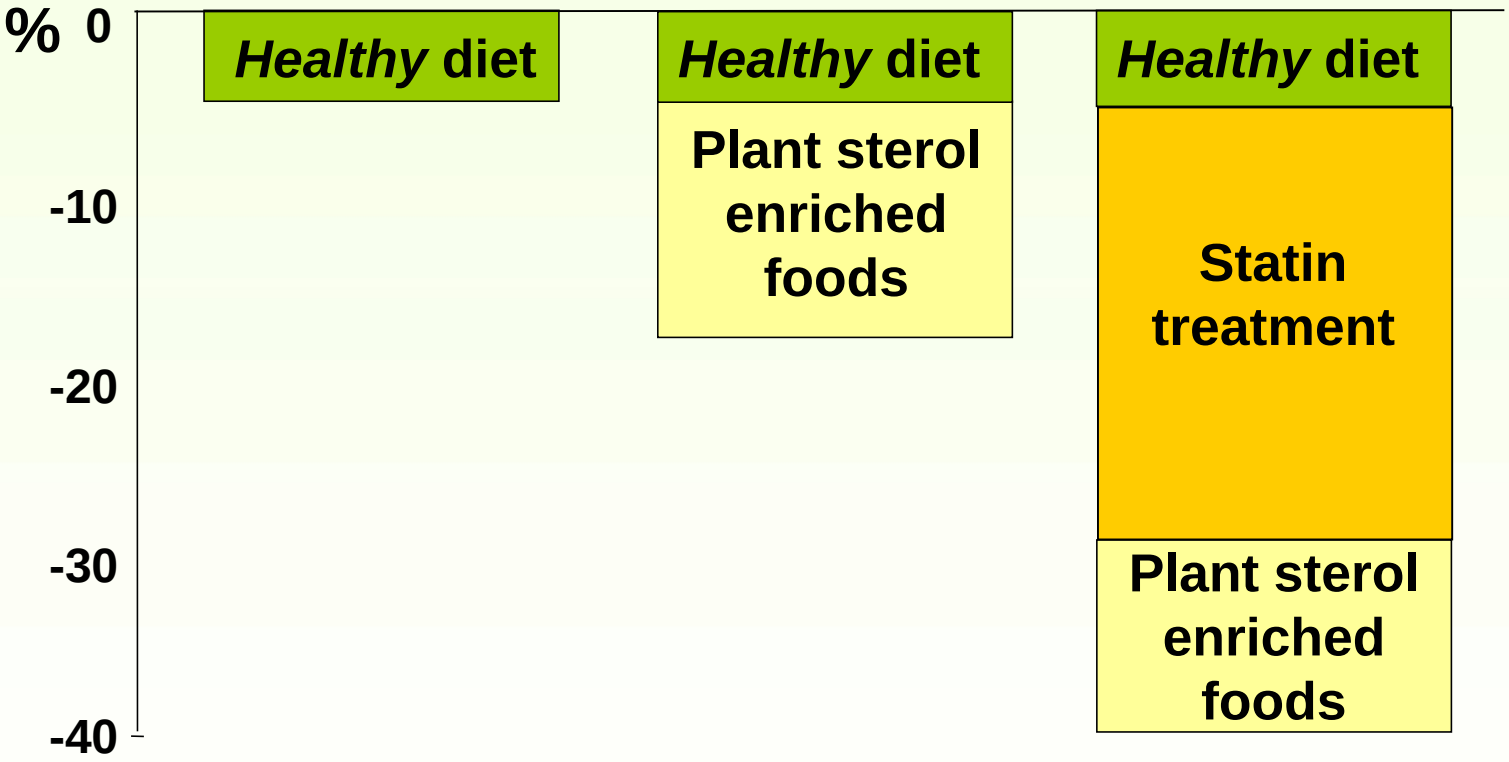
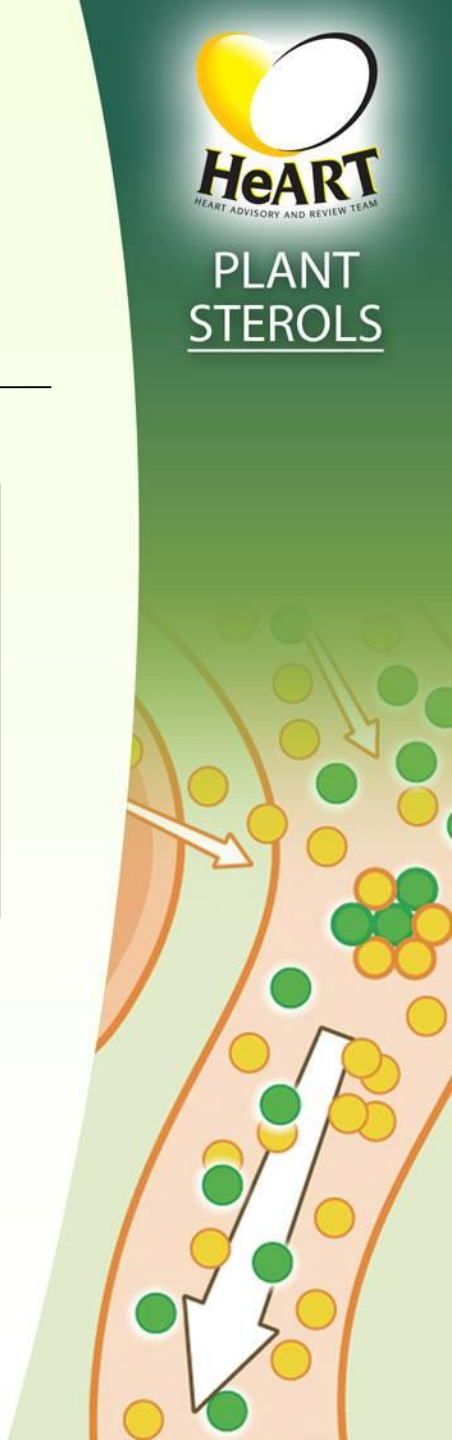
- **2g plant sterols can be obtained by eating:**
  - 425 tomatoes
  - 210 carrots
  - 150 apples
  - 83 oranges
  - 70 slices of wholemeal bread
  - 11 cups of peanuts.

- To get the optimal amount of plant sterols from regular foods would be extremely difficult
- Plant sterol enriched foods facilitate the consumption of the recommended intake of 2g of plant sterols/day.



Plant sterols have an additive cholesterol-lowering effect with lipid lowering medication





CASE STUDY– INTERACTIVE EXERCISE 1

- Mr Jones, 56 years and has smoked 20 cigarettes a day since the age of 18
- Total cholesterol 7.0mmol/L, HDL 1.1mmol/L, LDL 3.5mmol/L, TGs 2.3mmol/L
- Typical diet:
  - Breakfast: cereal with semi-skimmed milk & two slices toast with spread
  - Lunch: shop-bought sandwich and bag of crisps
  - Dinner: ready meal most nights, takeaways once a week
  - Alcohol: 25-30 units per week.

Interactive exercise

Break into groups to discuss suggested ways to lower lipid levels?

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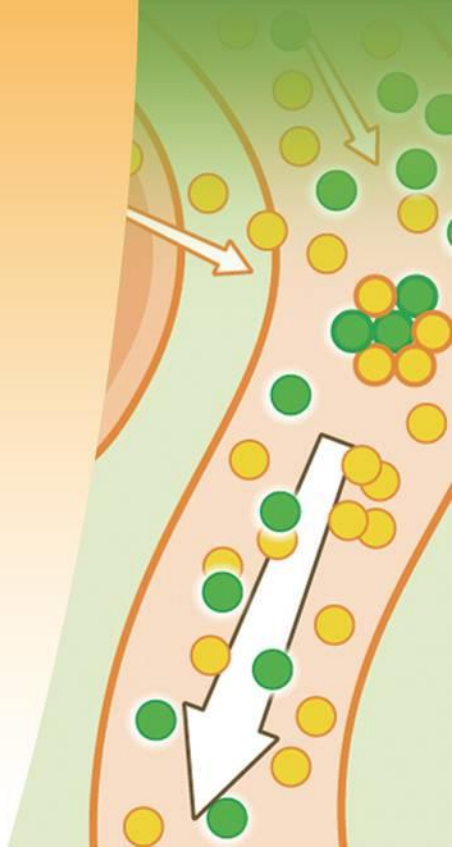
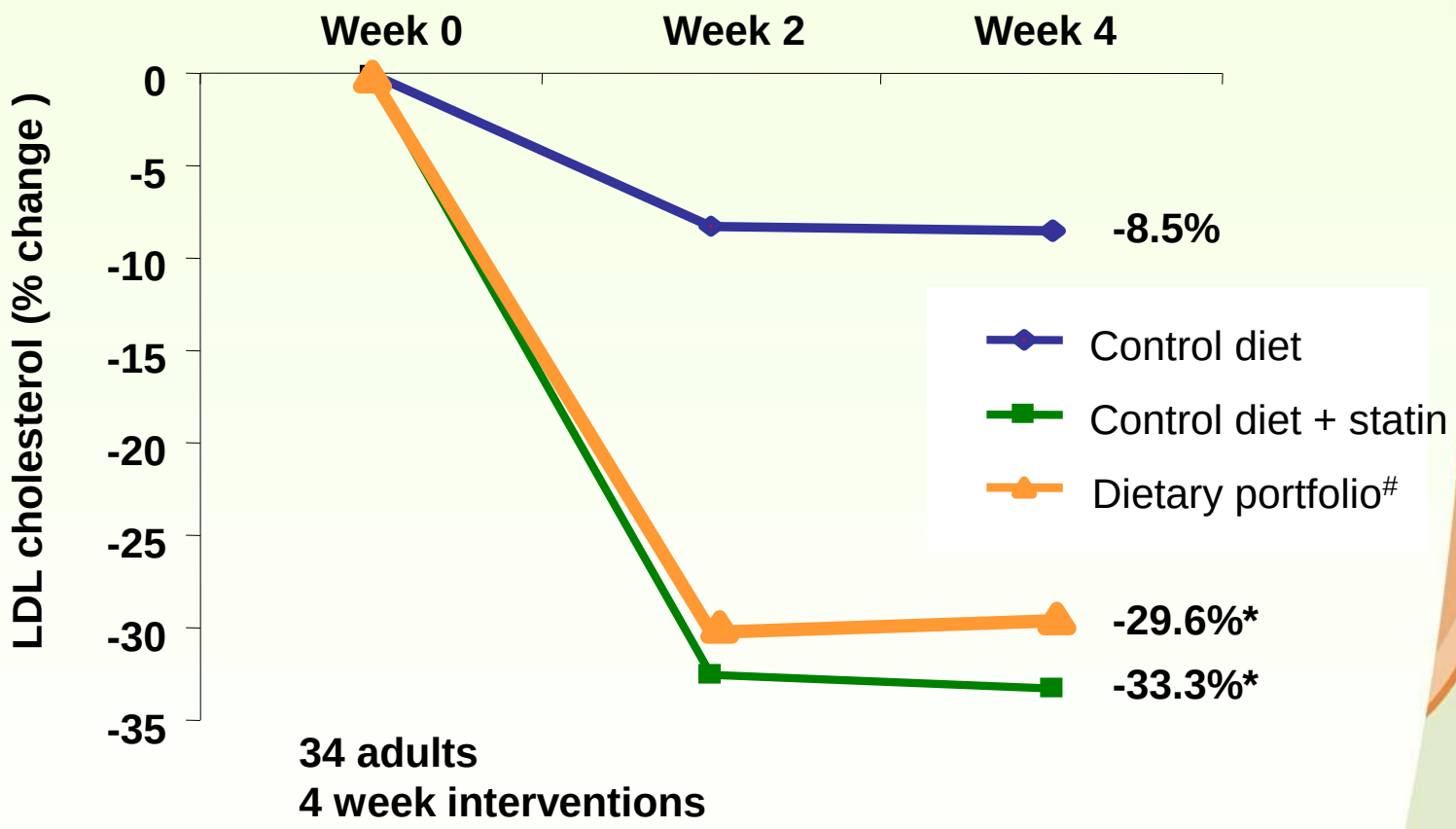


A dietary portfolio effectively reduces LDL- cholesterol levels



Dietary portfolio = plant sterols, soya protein, viscous fibre, almonds
* Significantly different from control (low saturated fat diet)

Longer term effects of portfolio diet in hypercholesterolaemia

- 12 month study involving 66 participants, of which 55 completed the trial
- Prescribed diets high in:
  - plant sterols (1.0g/1000 kcal)
  - soya protein (22.5g/1000kcal)
  - viscous fibre (10g/1000 kcal)
  - whole almonds (23g/1000 kcal)
- Results at 3 and 12 months: Mean LDL-cholesterol reduced by 14% & 12.8% respectively
- 32% of participants had LDL-cholesterol reductions of > 20%.

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Most effective way to lower cholesterol with dietary change is to include plant sterols or stanols

Dietary component	Dietary change	Approximate LDL-cholesterol reduction in %
Plant sterols and stanols	2-2.5g/day	10
Saturated fat	**<7% of energy**	**5-10**
Beta-glucan	**3g/day (3 bowls of porridge)**	**2-5**
Soya protein	**25g/day (4 portions)**	**3-5**
Body weight maintenance	**Lose ~ 5kg**	**5**

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International health authorities approve and support plant sterol-enriched foods

- EU regulations – Novel Foods
- FDA GRAS (Generally Regarded as Safe), US
- Australia New Zealand Food Authority approved
- Bundesamt fur Gesundheitswesen, Switzerland
- Ministry of Agriculture, Brazil
- Directorate of Food Control, South African
- FOSHU, Japan

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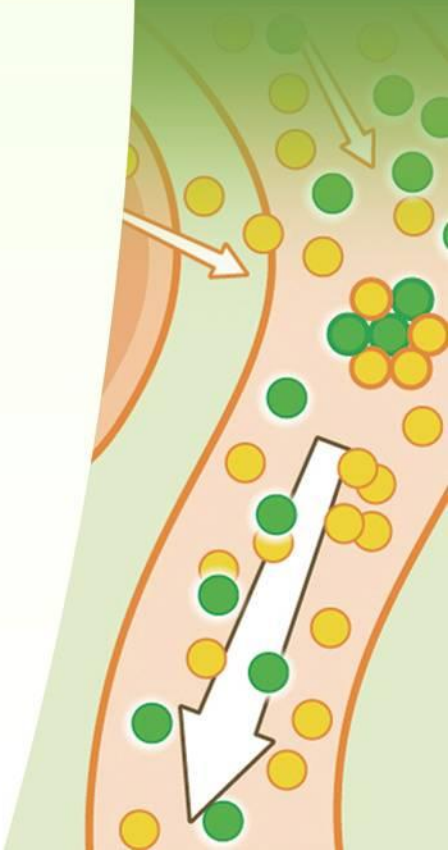
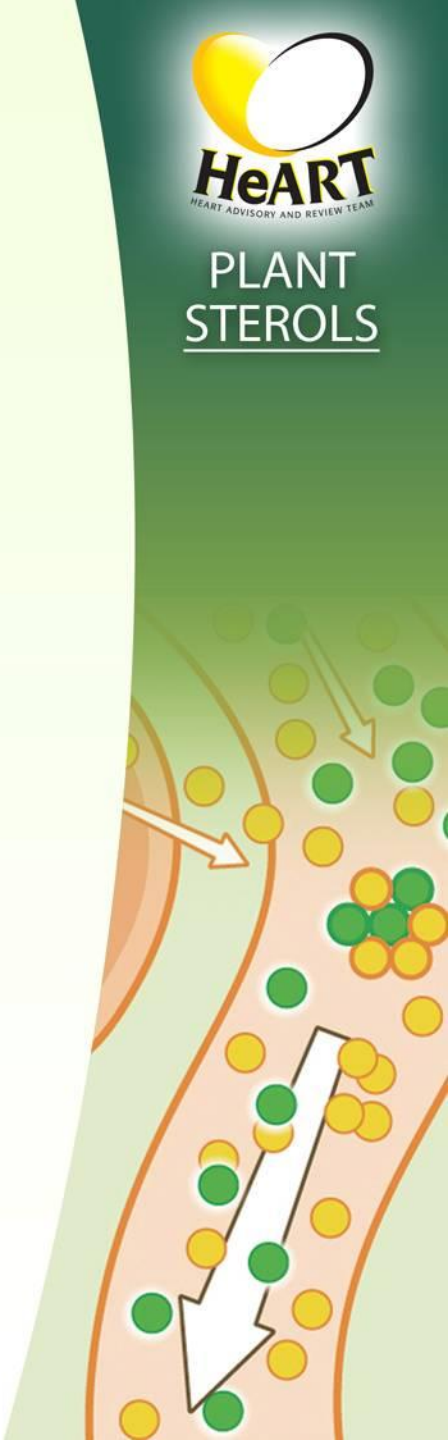


Dietary Guidelines



Dietary Guidelines - NCEP ATP III

Therapeutic Lifestyle Changes

- Weight reduction
- Increase physical activity
- Total fat intake: 25-35% of energy
- Reduce saturated fat intake (<7% of energy)
- Reduce cholesterol intake (<200 mg/day)
- Additional options for LDL-cholesterol lowering
    - **Plant sterols/stanols (2g/day)**
    - Soluble fibre (10-25g/day).

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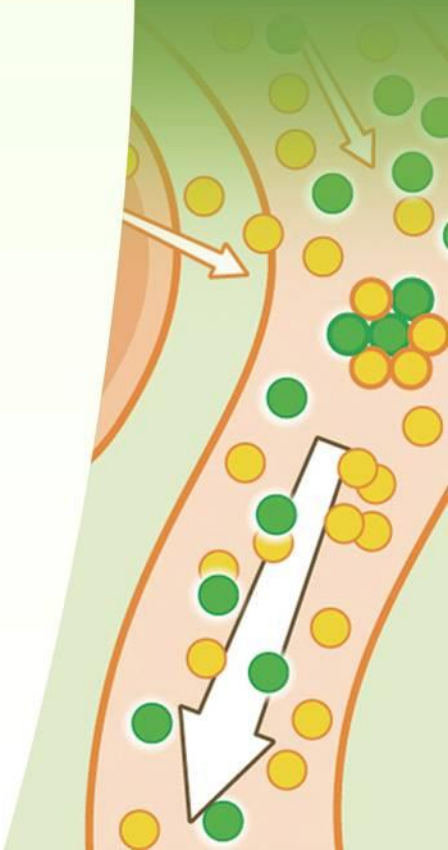

Dietary Recommendations – IAS

- **Reduce saturated fats** to <7% of total energy
- Keep intakes of **trans fatty acids low**
- **Maintain n-3 fatty acid intake** (in the form of alpha-linolenic acid) to at least 1% of total energy (2-3g/day)
  - Fish oil supplements for high risk patients are optional (EPA+DAH of 1g/day)
- **Reduce dietary cholesterol** to <200mg/day
- **Increase viscous fibre,** if possible to 10g/day
- Consume at least **five servings of fruits and vegetables** daily
- Ensure **adequate intake of folic acid** (400-1000 mg/day)
- **Avoid excess intake of alcohol**. Limit consumption to no more than 20-30g/day (men) and 10-20g/day (women)
- **Consider adding plant sterol/**stanol (2g/day) for elevated LDL-cholesterol.

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Summary of cholesterol-lowering of plant sterols

- Reproducible, robust effects
- Sustained with longer-term use
- Independent of the background diet (typical Western or low-fat)
- Proven compliance and efficacy in free-living populations (adults and familial hypercholesterolemia children)
- Additive effect to low saturated fat, low cholesterol lipid-lowering diet
- Additive effect to lipid-lowering medication (statins and fibrates)
- HDL-cholesterol not lowered
- Included in dietary guidelines.

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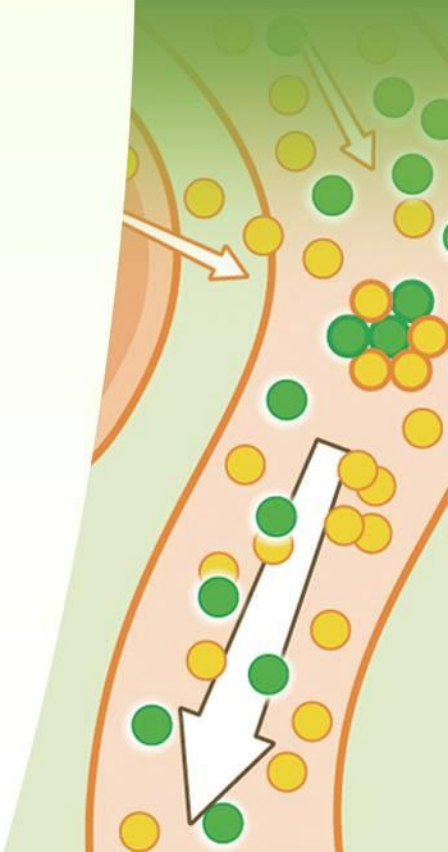

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Thank you

Questions?