Nutritional aspects of chocolate confectionery fats

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Doctors reject chocolate tax
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Doctors have narrowly rejected a call for a tax on chocolate to combat obesity.
Confectionery fats

- Stearic acid rich fats
  Cocoabutter
  Cocoabutter substitutes e.g. shea

- Medium chain fatty acid rich fats
  Coconut and palm kernel oil

- Hydrogenated and interesterified fats – e.g. SALATRIM
Diet and Cardiovascular disease (CVD)

- Age, gender & genes
- Smoking
- Physical inactivity
- Lipids
- Obesity
- Insulin resistance
- Haemostatic function

CVD
Hierarchy in Scientific Evidence

- Systematic Reviews (Meta-analysis)
  - Randomized Controlled Trials
  - Other Controlled Trials
  - Prospective Cohort studies
  - Case – Control studies
  - Prevalence studies
  - Ecological studies
  - Animal studies
The Risk Factors

- Stress
- Smoking
- Overweight
- Blood pressure
- Exercise
- Diabetes
- Heredity

Blood cholesterol
Total Cholesterol Distribution: CHD vs Non-CHD Population

Framingham Heart Study—26-Year Follow-up

35% of CHD Occurs in People with TC<5.2 mmol/L
Metabolic Syndrome Increases Risk for CHD and Type 2 Diabetes

High LDL-C → Metabolic Syndrome → Type 2 Diabetes → Coronary Heart Disease
Blood lipid metrics of risk of CHD

Prospective Studies Collaboration. Lancet 2007;9602:1829-1839
Predicted changes (Δ) in the ratio of serum total to HDL cholesterol and in LDL- and HDL-cholesterol concentrations when carbohydrates constituting 1% of energy are replaced isoenergetically with saturated, cis monounsaturated, cis polyunsaturated, or trans monounsaturated fatty acids.

Predicted changes in the ratio of serum total to HDL cholesterol and in LDL- and HDL-cholesterol concentrations when carbohydrates constituting 1% of energy are replaced isoenergetically with lauric acid (12:0), myristic acid (14:0), palmitic acid (16:0), or stearic acid (18:0)

Predicted changes (Δ) in the ratio of serum total to HDL cholesterol when mixed fat constituting 10% of energy in the "average" US diet is replaced isoenergetically with a particular fat or with carbohydrates.

Effect on risk of CHD events of replacing 5% energy saturated fatty acids from pooled analysis of 11 cohort studies

Meta-analysis of trans fatty acids on risk of CHD events

- SHS 2006
- ATBC 1997
- HPFS 1996
- NHS 1996
- Zutphen 2005
- All studies

Decreases

Increases
Replacing 2% trans fatty acids with saturated or unsaturated fatty acids reduces risk of CHD

WHO/FAO
2009
Effects of high stearic acid fats

- Total cholesterol/ HDL cholesterol – neutral

- Postprandial lipaemia

- Clotting, fibrinolysis and endothelial function

- Insulin sensitivity
Thrombosis and fibrinolysis
THE NORTHWICK PARK HEART STUDY
CHD DEATHS BY THIRDS OF DISTRIBUTION

Meade et al (1986) Lancet i, 1052
Effect of different chain length fatty acids on postprandial lipaema

Change in plasma triglycerides after test meal

- 18:1 cis
- 18:1 trans
- 18:0
- 16:0
- MCT
- Low fat

Sanders et al. Atherosclerosis 2000, 149: 413-420
Postprandial lipaemia

Area under curve

Statistical significance of $F$ value $P < 0.0001$

Postprandial change in FVIIa following meals enriched in specific fatty acids

Sanders et al Atherosclerosis 2000, 149: 413-420
SALATRIM
(Short and long triacylglycerol mixture)

Decreased energy value 5 kcal/g, stearic acid plus SCFA
Mean change in plasma TAG from fasting with 95% CI

SALATRIM STUDY

Structured stearic rich TAG (SALATRIM) meal decreased FVIIc and FVIIa

Conflicting results have been obtained of the effect of stearic rich TAG on postprandial lipaemia, which may be a consequence of different TAG structure.

Saturated fatty acids are better absorbed as a 2-MAG than as free fatty acids.
Stearate in Cocoabutter

- Stearate
- Oleate
- Stearate/Palmitate
Randomized vs Unrandomized cocoabutter

Randomized cocoabutter (asymmetrical TAG) versus unrandomized cocoabutter (symmetrical TAG)

Postprandial change in FVIIa

Change in Factor VII:a from fasting units/L

-15 -10 -5 0 5 10 15

3h 6h

P<0.05

Unrandomized CCB
Randomized CCB

Randomized stearic acid rich TAG* (asymmetrical TAG) versus unrandomized cocoabutter (symmetrical TAG)

* Same as that used in Sanders et al (2000)
Differential scanning calorimetry

Cocoabutter

Randomised SART
Berry et al (2007) AJCN

Weeks

0 →

Low-stearic acid run-in period

3 → LSA - PPT

HSA - RSB diet
30 g/d

HSA - URSB diet
30 g/d

6 → HSA - PPT

Low-stearic acid washout period

10 → LSA - PPT

HSA - RSB diet
30 g/d

HSA - URSB diet
30 g/d

13 → HSA - PPT

Habitual diet washout period

17 →

URSB PPT

HOC PPT

Habitual diet washout period

18 →

URSB PPT

HOC PPT

<table>
<thead>
<tr>
<th>Treatment</th>
<th>LDL cholesterol mmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shea butter</td>
<td>0.4% NS</td>
</tr>
<tr>
<td>Randomized Shea</td>
<td>-3.2% NS</td>
</tr>
</tbody>
</table>

Graph: Low stearate vs Treatment

0% NS

5.7% NS

HDL cholesterol mmol/L

Shea butter

Randomized Shea

Low stearate

Treatment
Unrandomized Shea butter vs high oleic sunflower oil

Plasma TAG (mmol/L) vs Time (h)

- **Diet x time effect**
P<0.001

- **Incremental area under curve**
P=0.017
Shea butter does not activate FVII postprandially

Endothelial Dysfunction in Atherosclerosis
Endothelial function measurement

Pre-occlusion   Post occlusion   Post GTN

4.5 mm

5.0 mm, FMD = 11%

5.3 mm, 18%
Postprandial lipaemia and vascular function

HOS = high oleic sunflower oil
Shea = stearic acid rich fat (SOS)

Research

Stearic acid-rich interesterified fat and trans-rich fat raise the LDL/HDL ratio and plasma glucose relative to palm olein in humans

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Nutrition & Metabolism 2007, 4:3 doi:10.1186/1743-7075-4-3
Sundram et al (2007) comparisons with palm olein
Changes in fasting glucose reported by Sundram et al (2007)
Sundram et al. 2007
Plasma insulin before and after native and randomized shea butter

Plasma glucose before and after native and randomized shea butter
Conclusions

1. Chocolate confectionery fats do not have an adverse effect on the lipid profile.

2. Chocolate confectionery fats are potentially less thrombogenic than high monounsaturated oils such as olive oil and high oleic sunflower oil.

3. Postprandial lipaemia and consequently changes in haemostatic function may be favourably reduced if the solid fat index at 37°C is high.

4. There is no consistent effect of stearic acid rich fats on insulin and glucose but more research is needed.

5. Chocolate confectionery is high in calories and excessive intakes contribute to obesity.
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