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Effects of Rapeseed Oil and Sunflower Oil on Serum Lipoproteins of Healthy Subjects

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We compared the effects of low-erucic acid (< 1%) rapeseed oil and sunflower oil on serum and lipoprotein lipid levels in 59 healthy subjects, 30 women and 29 men, aged 18-65 years. They consumed three diets with a similar fat content but a different fatty acid composition. For two weeks a baseline diet rich in saturated fat was consumed: total fat 35.8 E%, saturated fatty acids (SAFA) 18.9 %, monounsaturated fatty acids (MUFA) 11.0 %, polyunsaturated fatty acids (PUFA) 3.7 % followed by a diet rich in sunflower oil: total fat 37.7 E%, SAFA 12.7 %, MUFA 10.2 %, PUFA 13.3 % and a diet rich in rapeseed oil: total fat 37.8 E%, SAFA 12.4 %, MUFA 16.2 %, PUFA 7.6 %, for 3.5 weeks each in a random and double-blind cross-over design. The diets contained similar amounts of cholesterol (315-360 mg/d) and dietary fibre (29-30 g/d).

The oils were incorporated into mixed natural diets which included special margarines, specially prepared bread, salad dressing and ice cream. Every weekday the participants had lunch together and received the food for the rest of the day and for the following morning. Food for the whole weekend was provided each Friday. The foodstuffs were weighed for each participant. About 90% of the food consumed during the study periods was provided for the subjects. The consumption of freely chosen foods and deviations from the prescribed diet were recorded in diaries. Body weight was recorded twice weekly and energy intake was adjusted accordingly to prevent weight changes. Duplicate portions of the diets were collected daily and pooled for each period.

Fasting blood samples were drawn on two days during the last week of each diet period. Serum total cholesterol, HDL-cholesterol (after precipitation with dextran sulfate and $MgCl_2$) and triglycerides were assayed by enzymatic methods in all samples. Lipoprotein analysis was done of one serum sample from each period. This included separation of VLDL, LDL, HDL_2 and HDL_3 by the analytical ultracentrifuge and the analysis of apoproteins (apo) A-I and B by immunoturbidometry. The fatty acid composition of plasma phospholipids was determined by gas chromatography.

At the end of the baseline period the serum total cholesterol concentration of the subjects was 5.35±0.98 mmol/l (mean±SD), LDL-cholesterol 3.17±0.82 mmol/l, HDL-cholesterol 1.33±0.28 mmol/l and triglycerides 0.88±0.37 mmol/l. The sunflower oil diet reduced serum total cholesterol to 4.62±0.87 mmol/l (-12 %) and LDL-cholesterol to 2.58±0.70 mmol/l (-17 %). During rapeseed oil diet serum total cholesterol fell to 4.52±0.80 mmol/l (-15 %) and LDL-cholesterol to 2.41±0.67 mmol/l (-23 %). The differences between sunflower oil and rapeseed oil were statistically significant ($p<0.01$). No difference was found in HDL-cholesterol between the sunflower oil and rapeseed oil periods. The HDL_2-cholesterol level was lower after sunflower oil than after rapeseed oil but HDL_3 showed no difference between the two periods. The serum triglyceride level was lower after the sunflower oil as compared with the rapeseed oil period. This was due to lower levels of both VLDL- and LDL-triglyceride during the sunflower oil diet. The apo A-I concentration was higher (1.45±0.25 g/l) during the rapeseed oil than during the sunflower oil period (1.23±0.24 g/l, $p<0.001$)

but the apo B levels showed no difference. The apo A-I to apo B ratio was 2.23±1.09 after the baseline diet, 2.39±1.60 after the sunflower oil diet and 3.00±1.36 after the rapeseed oil diet ($p<0.001$ for difference between sunflower oil and rapeseed oil). Also the HDL_2 to LDL-cholesterol ratio was more favourable (0.43±0.19) after rapeseed oil than after sunflower oil (0.39±0.18, $p<0.01$). The ratio of oleic acid to linoleic acid in plasma phospholipids was 0.49±0.07 after the baseline diet. It was reduced to 0.27±0.04 ($p<0.001$) during the sunflower oil diet and increased to 0.56±0.07 ($p<0.01$) during the rapeseed oil diet reflecting good compliance to the diets.

Both sunflower oil and rapeseed oil reduced serum total and LDL-cholesterol levels of healthy subjects when substituted for milk fat in the diet although the amounts of total fat and cholesterol in the diet were not reduced. The LDL-cholesterol concentration was significantly lower after rapeseed oil but the difference to sunflower oil was very small. Sunflower oil reduced VLDL-cholesterol and -triglyceride levels and HDL_2-cholesterol and apo A-I levels compared to rapeseed oil. This resulted in a clearly more favourable relationship between HDL_2- and LDL-cholesterol and between apo A-I and apo B during rapeseed oil as compared to sunflower oil. Low-erucic acid rapeseed oil is rich in oleic acid (58%) and contains also n-3 alpha-linolenic acid (13%) whereas linoleic acid (65%) is the main component of sunflower oil. On the basis of the present study it is not possible to determine, whether the effects of rapeseed oil on lipoproteins depend mainly on its content of oleic acid or alpha-linolenic acid or both. High oleic acid rapeseed oil specifically affects the metabolism of LDL, whereas sunflower oil high in linoleic acid seems to affect the metabolism of VLDL and HDL in addition to LDL.

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