The acute effect of olive oil on postprandial thermogenesis and substrate oxidation in postmenopausal women

MJ Soares[1], S Cummings[2], JC Mamo[1], LS Piers[3] and MA Kenrick[1]

[1]*Department of Nutrition, Dietetics & Food Science, Curtin University of Technology, Perth, WA, 6845*
[2]*Department of Human Movement & Exercise Science, University of Western Australia, Perth, 6009*
[3]*Menzies School of Health Research, Casuarina, NT, 0811*

The prevalence of obesity in postmenopausal women is high. The ability of the body to oxidize digestible fat significantly influences fat balance. Differences in fatty acid oxidation stem from differences in chain length, degree of unsaturation, the position and stereoisomeric configuration of double bonds (1,2). Since the source of fat determines the eventual mix of fatty acids in the diet, we used a whole food approach to examine the influence of the source of dietary fat on postprandial thermogenesis and substrate oxidation rates in postmenopausal women. The study consisted of a single blind, paired comparison of two high fat, isocaloric, mixed test meals where the major source of fat was either cream (CREAM) or extra virgin olive oil (EVOO). Twelve postmenopausal women, aged 57–72 years and body mass index (BMI) between 21.9–38.3 kg/m^2 were studied. Fasting and postprandial oxygen consumption, carbon dioxide production and urinary nitrogen excretion were used to estimate resting metabolic rate (RMR), diet induced thermogenesis (DIT) and substrate oxidation rates over 5h. Fat mass (FM) and fat free mass (FFM) were estimated from skinfold thickness and Durnin & Womersley's equations (3).

There was no difference in body weight, RMR, fasting carbohydrate or fat oxidation rates on the two occasions. DIT (in kJ/5h, or as percent of energy intake) did not significantly differ between the two test meals. In a paired comparison, the change in postprandial carbohydrate oxidation rate ($\triangle$COX) [$\triangle$COX = average postprandial oxidation – fasting oxidation] was significantly lower ($P = 0.027$), while the change in postprandial fat oxidation rate ($\triangle$FOX) was significantly higher ($P = 0.028$) following the EVOO meal. These results support our recent observations in younger men (2).

Obesity is often associated with a low DIT. To further understand the influence of obesity, we categorized the data into low BMI (LB) and high BMI (HB) groups, based on the median BMI value (32.6 kg/m^2). A 2X2 ANOVA showed that DIT adjusted for FFM, was significantly lower in the HB group compared to the LB group (2.5 ± 0.73 vs. 7.5 ± 0.73%, $P = 0.001$). There also was a significant BMI group X test meal interaction ($P < 0.03$) which indicated that olive oil had a stimulatory effect on DIT in the HB group. There was no statistically significant effect of BMI grouping on either carbohydrate or fat oxidation. However, fat oxidation was significantly higher with the EVOO meal (0.05 ± 1.23 vs. -3.65 ± 1.23, $P < 0.05$) while carbohydrate oxidation showed a trend to be lower (10.5 ± 2.86 vs. 17.6 ± 2.86, $P < 0.10$).

In conclusion, substitution of cream with extra virgin olive oil significantly increased fat oxidation in postmenopausal women, and stimulated diet induced thermogenesis in the HB group. Overall, the results could favour a role for olive oil in the dietary management of human obesity.

References

1. DeLany JP, Windhauser MM, Champagne CM, Bray GA. Differential oxidation of individual dietary fatty acids in humans. Am J Clin Nutr 2000; 72: 905–911.
2. Piers LS, Walker KZ, Stoney RM, Soares MJ, O'Dea K. The influence of the type of dietary fat on postprandial fat oxidation rates: monounsaturated (olive oil) vs saturated fat (cream). Int J Obes 2002; 26: 814–21.
3. Durnin JGVA, Womersley J. Body fat assessed from total body density and its estimation form skinfold thickness: measurements on 481 men and women aged 16 to 72 years. Br J Nutr 1974; 32: 77–97.

Key words: thermogenesis, olive oil, fat oxidation