ASSESSMENT OF THE NUTRITIONAL PROPERTIES OF LOW-LINOLENIC (LL) CANOLA OIL WITH HUMAN SUBJECTS

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ABSTRACT

The nutritional properties of low α-linolenic acid canola oil (LL-CAN) were compared with regular canola oil (CAN) and sunflower oil (SUN) in a 42-d nutrition study with normolipidemic men and women. LL-CAN, CAN and SUN were equally effective in lowering plasma total and LDL cholesterol levels. Dietary fat source had no effect on plasma HDL levels or size of LDL particles. However, LDL of subjects fed the SUN diet, which contained higher levels of PUFA, were more susceptible to oxidation than those of subjects fed the LL-CAN, CAN or control (usual) diet. Dietary fat source, also, had no effect on bleeding time or bleeding-time eicosanoid production. No major differences in the nutritional properties of LL-CAN and CAN were found in this study.

INTRODUCTION

Canola oil (CAN) is widely accepted as a highly nutritious dietary fat source. It was found as effective as sunflower (SUN), soybean and safflower oils in lowering plasma total and LDL cholesterol levels in normolipidemic subjects (McDonald et al., 1989; Chan et al., 1991; Wardlaw et al., 1991; Valsta et al., 1992). Several studies also found CAN altered parameters linked with thrombosis which, like atherosclerosis, is a major event leading to cardiovascular disease. CAN has been found to alter platelet n-3 fatty acid content (Renaud et al., 1986; Weaver et al., 1991; Chan et al., 1993) and to reduce *in vitro* platelet aggregation (Renaud et al., 1986; Kwon et al., 1991). This effect of CAN has been attributed to the relatively high level of α-linolenic acid (LNA). Low-LNA canola oil (LL-CAN), however, has been found more stable to oxidation than regular CAN (Eskin et al., 1989). Hence, the present study was undertaken to assess the nutritional properties of LL-CAN.

EXPERIMENTAL

Sixty-four subjects (32 women and 32 men) with normal blood lipid patterns were assigned at random to four diets: control (customary) diet; and 3 diets in which 60% of the usual fat was replaced by CAN, LL-CAN or SUN for a 42-d period. Fasting blood samples were taken on Day 1 and Day 42. Plasma triglyceride (TG) and total and HDL (apo B lipo-

protein ppt'd with phosphotungstate/ magnesium) cholesterol levels were determined enzymatically as described by Chan et al. (1991). Cu-induced conjugated diene production (Jialal and Grundy, 1992) was used to measure the oxidative stability of the LDL fraction. Plasma vitamin E was determined by HPLC (Driskell et al., 1982). Mean LDL particle size was determined by the method of van Heek and Zilmersmit (1991). Fatty acid composition of the lipid in LDL, bleeding times and bleeding-time eicosanoid production were determined as describe by Chan et al. (1992).

RESULTS

There were no differences due to sex for any of the parameters measured in this study. Replacing 60% of the customary fat in the control diet with CAN, LL-CAN or SUN resulted in lower ($p < 0.05$) levels of plasma total and LDL cholesterol (Table 1). Dietary fat source, however, had no effect on plasma HDL or TG levels or mean LDL particle size. LDL particles from subjects on the SUN diet were less oxidatively stable than those from subjects on the Control, CAN and LL-CAN diets even though there were no differences in plasma vitamin E levels among the groups; LDL from the SUN group contained a higher level ($p < 0.05$) of total PUFA than the other diets (53.1% vs 45.2%, 46.2%, 47.2%, resp.). Dietary fat source did not alter bleeding times or bleeding-time thromboxane A_2 or prostacyclin production even though the CAN diet contained higher levels of LNA than the LL-CAN, control and SUN diets (7.9, 2.3, 1.9 and 0.9%, resp.).

DISCUSSION

LL-CAN was as effective as CAN and SUN in lowering plasma total and LDL cholesterol, which coincides with reports that oleic acid is as effective as linoleic acid in lowering plasma cholesterol (Mensink and Katan, 1989; McDonald et al., 1989; Wardlaw et al., 1991; Valsta et al., 1992). Likewise, LL-CAN had no effect on HDL levels nor were there any differences in average LDL particle size due to dietary fat source; small, dense LDL particles are more common in patients with conditions associated with atherogenesis (Slyper, 1994). There was a difference, however, in the oxidative stability of the LDL fraction due to dietary fat source. The greater oxidative stability of LDL from subjects fed the LL-CAN and CAN diets coincides with greater LDL stability for subjects fed oleic acid-enriched than linoleic acid-enriched diets (Reaven et al., 1991; Abbey et al., 1993). Similarity in the oxidative stability of LDL lipid for the LL-CAN and CAN groups conformed with the like LDL fatty acid patterns for the two groups even though the diets differed in 18:2n-6 and 18:3n-3 content (26.5 vs 21.4% and 2.3 vs 7.9%, resp.). There were no differences due to dietary fat source in bleeding time or bleeding-time eicosanoid production even though previous studies (Renaud et al., 1986; McDonald et al., 1989; Kwon et al., 1991) have reported a favorable effect of canola oil on factors associated with thrombosis.

CONCLUSIONS

No differences in the nutritional properties of low-linolenic acid canola oil (LL-CAN) and regular canola oil (CAN) were found by the parameters measured in this study.

TABLE 1. Plasma total, LDL and HDL cholesterol (mmol/L) and vitamin E (μmol/L), calculated LDL particle size (dia. in Å) and oxidative stability of LDL (rate of Δ Absorption$_{240}$, 10^{-3}).

Parameter	Control Diet	CAN Diet	LL-CAN Diet	SUN Diet
Plasma Total Chol.	4.47[a]	4.06[b]	3.97[b]	3.87[b]
Plasma LDL Chol.	2.71[a]	2.31[b]	2.10[c]	2.17[b,c]
Plasma HDL Chol.	1.29[a]	1.22[a]	1.36[a]	1.28[a]
Plasma vitamin E	21.4[a]	19.2[a]	20.3[a]	21.3[a]
Mean LDL Diameter	205[a]	210[a]	203[a]	198[a]
Conj. Diene Form'n	8.20[a]	8.98[a]	9.00[a]	10.86[b]

[a,b,c] Numbers in rows with different superscript letters differ significantly ($p < 0.05$).

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