AVOCADO OILS AND HEPATIC LIPID METABOLISM IN GROWING RATS

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Abstract—The effect of various avocado oils on liver metabolism was studied in growing female rats. The rats were fed diets containing 10% (w/w) avocado oil for 4 wk. In comparison with rats fed refined avocado oil obtained from cored fruit by centrifugal separation, rats fed unrefined avocado oil obtained by organic solvent extraction from intact fruit, or its unsaponifiable components, showed a significant increase in total liver lipogenesis as well as in phospholipid and triglyceride synthesis. Rats fed avocado-seed oil exhibited enhanced [\(1^4\)C]acetate incorporation into total liver lipids but showed the same distribution of label in the three main lipid classes as that of rats fed refined avocado oil. In addition, a significant reduction of triglycerides and protein content of plasma very-low-density lipoprotein and high-density lipoprotein fractions was observed in rats fed avocado-seed oil as compared with rats fed refined oil. Electron micrographs suggested that the alterations in hepatic lipogenesis are related to the marked proliferation of the smooth endoplasmic reticulum, which is known to be associated with induction of enzymes involved with lipid biosynthesis. The differences between the animals fed seed oil and those fed the unrefined oils, in the distribution of label within the main lipid classes, indicate that more than one factor is involved in the alterations caused by these oils.

INTRODUCTION

In a previous study (Werman et al., 1989) four dietary avocado oils were compared: refined avocado oil obtained from cored fruit, unrefined avocado oil extracted from intact fruit, unsaponifiable fraction of the unrefined oil and avocado-seed oil. All the oils except for the refined oil caused alterations in liver metabolism such as liver enlargement, elevated levels of serum alkaline phosphatase activity and a reduction in serum triglyceride content, which was accompanied by an increased amount of hepatic lipids. These findings indicate the possibility of the presence of some hepatotoxic agents in the seed oil.

Accumulation of lipids in the liver may be manifested under the following conditions (Lyman et al., 1964): (a) increased uptake of dietary fat or adipose tissue fatty acids by the liver; (b) increased fatty acid synthesis; (c) decreased fatty acid oxidation by the liver; and (d) decreased secretion of lipoproteins from the liver into the bloodstream.

The purpose of this study was to evaluate the effect of dietary avocado oils on liver lipid biosynthesis in order to gain more knowledge on the mechanism by which these oils exert their effect.

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Abbreviations: ANOVA = analysis of variance; HDL = high-density lipoproteins; LDL = low-density lipoproteins; LP = lipoproteins; LSD = least significant difference; PL = phospholipids; RAO = refined avocado oil; SER = smooth endoplasmic reticulum; TEM = transmission electron microscope; TLC = thin-layer chromatography; TG = triglyceride; URAO = unrefined avocado oil; VLDL = very-low-density lipoproteins.

MATERIALS AND METHODS

Animals and diets. Female Charles River CD rats weighing 80-100 g were obtained from the animal colony of the Department of Food Engineering and Biotechnology, Technion, Israel. They were randomly divided into five groups, each of seven rats, and housed individually in a temperature-controlled room (25°C) with a 12-hr light/dark cycle. Food and water were supplied ad lib. except to the pair-fed group. Food consumption of all dietary groups was recorded daily. Each group was fed the basic diet, ground commercial rat feed (obtained from Asia Maabarot Ltd, Kibbutz Maabarot, Israel) supplemented at a level of 10% (w/w) with avocado oil derived from different sources as detailed previously (Werman et al., 1989): Group A—refined avocado oil (RAO), Hass variety; Group B—9% RAO containing 1% avocado-seed oil, Hass variety; Group C—unrefined avocado oil (URAO), Fuerte variety; Group D—9.5% RAO containing 0.5% unsaponifiable components of URAO, prepared according to the official method of the American Oil Chemist’s Society (1974).

To exclude possible changes due to low food consumption, a group pair-fed with the rats fed seed oil (Group B, which showed in preliminary experiments the lowest food consumption), was introduced. The pair-fed group was maintained on the diet containing RAO as in Group A.

Experimental. At the end of the 4-wk feeding period, the rats were fasted for 12 hr and then killed by carbon dioxide asphyxiation. Blood samples were drawn by heart puncture. The abdominal cavity was opened and the liver was removed, blotted and weighed. One lobe was sliced and used for...