Liver Fatty Acid and Element Changes After Partial Hepatectomy in Mice Fed Olive Oil– and Corn Oil–Enriched Diets

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ABSTRACT

The purpose of this study was to explore the effect of dietary fats on the hepatic fatty acid profile of mice liver after partial hepatectomy and to observe a correlation with changes in element content. Male Balb/C mice were divided into three groups: the control animals fed a standard diet (FSD), the FOO group fed a diet enriched with 5% olive oil, and the FCO group fed a diet enriched with 5% corn oil. Hepatic fatty acid and element content were analyzed within each group in intact animals and on d 1, 2, and 7 after partial hepatectomy. During the regenerative process, proportions of 18:1n-9 and 18:3n-6 substantially increased in the FSD diet, correlating with the Zn level. On the other hand, 20:4n-6 and 22:6n-3 decreased on d 1 and 2. Consequently, a significant increase in the n-6 : n-3 ratio was found in these animals. In the FOO diet, a decreased polyunsaturated fatty acid/monounsaturated fatty acid (PUFA/MUFA) ratio was related to a significant decrease in PUFA content, mainly the result of decreased 20:3n-6 and 20:4n-6. The proportion of 18:1n-9 was increased compared with other diets and remained high during the regeneration. Furthermore, the n-6 : n-3 ratio was increased on d 2 and 7. Zn increased on d 1 and 2, and Fe increased on d 2. Feeding with corn oil generally induced an increase in the PUFA n-6 series, compared with other diets. The PUFA n-3 series decreased and the 18:1n-9 increased on d 1, compared to intact animals. Consequently, the n-6 : n-3 ratio was elevated during the regeneration. Zn increased on d 1 and 2, whereas Fe remained unchanged.

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until d 7, when it decreased. Decreased 20:4n-6 on d 1 and 2, as well as Cu on d 7, and increased Zn in the first 2 d were common to all three diets. These findings suggest that some significant signals transmitted during the regenerative process have induced alterations in the fatty acid composition and changes in the liver element content, which can be modified by the diet.

**Index Entries:** Zinc; iron; copper; magnesium; olive oil; corn oil; liver regeneration.

**INTRODUCTION**

Liver regeneration is a highly controlled process of the proliferation of both parenchymal and nonparenchymal liver cells (1,2). It appears as a response to injuries of the liver tissue, such as partial hepatectomy (PHx). Metabolic changes after PHx are mainly involved in the process of regeneration and the compensatory maintenance of a homeostatic state (3). After restoration of original liver mass, growth is completely stopped (4). Liver regeneration presents a model of regenerative growth of tissues in adult animals (5).

Elements such as zinc (Zn), copper (Cu), iron (Fe), and magnesium (Mg) play an important role in biological processes, including cell proliferation. They also interfere with the metabolism of lipids, specifically fatty acids. Long-chain fatty acids enhance Zn absorption, where saturation and a longer chain appear to be positive factors (6). Furthermore, low Zn intake prevents the accumulation of long-chain fatty acids and differentially depletes stores of some fatty acids. Cu plays a major role in redox reactions, participating via the Haber–Weiss reaction in the generation of free oxygen radicals, which can react with lipids, proteins, or DNA, promoting cellular damage (7). Mg deficiency perturbs essential fatty acid metabolism and decreases the cellular membrane polyunsaturated fatty acid (PUFA) content (8). Similarly, Fe deficiency is related to abnormal fatty acid shifts that disturb the delicate balance of essential fatty acids in membranes (9).

A Mediterranean diet, rich in cereals, fresh vegetables, and olive oil (mostly oleic acid, 18:1n-9), has been associated with lower risk of cancers of the colon, breast, bladder, and prostate (10,11). It has been suggested that olive oil could also have a positive effect on the prevention of a variety of chemically induced tumors (12). Several studies support the notion that the composition of fatty acids is more critical to colon cancer risk than is the total ingested dietary amount of fat (13). Corn oil provides essential fatty acids, mostly linoleic acid, 18:2n-6. 18:2n-6 is necessary for the integrity of the skin, cell membranes, the immune system, and for synthesis of eicosanoids (14). However, recent epidemiological and experimental data have linked a high dietary intake of n-6 PUFAs such as 18:2n-6, especially in association with a low intake of n-3 PUFAs such as 22:6n-3, to increased risks for cancers of the breast or colon (15,16).