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# Effect of Different Diet on the Lung Fatty Acid Modification

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The effect of dietary fat on the composition of lung fatty acids was studied in Fischer rats fed two experimental semisynthetic, isocaloric diets containing different qualities of fat (low fat diet (LFD) and medium-chain triacylglycerols diet (MCTD)).
The effect of MCTs preparation on the lung phospho- and neutral lipids is manifested as a change in the degree of saturation expressed as a ratio of saturation index ($RS_i$) MCTD *vs.* CD. The saturation increased; in neutral lipids by 70%, in phosphatidylcholine fraction by 152.6%, and in other phospholipids by 39.5%.
The results on the fatty acid composition of lipids obtained using LFD showed the effect of desaturation expressed as a ratio of desaturation index ($RD_i$), in phosphatidylcholine fraction –1.95.
The observed effect of desaturation was a consequence of the administered LFD, which contains a lower amount of essential fatty acids, which strongly affects the conversion of palmitic acid into palmitooleic acid. The LFD can be useful as a carbohydrate diet in a special clinical situation only if enriched with a certain amount of essential fatty acids, especially linoleic acid.

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## INTRODUCTION

Fat as a noncarbohydrate species is one of major nutrients in human food; new information suggests that certain fats may be metabolically active and may, therefore, offer distinct nutritional advantages.[1–4] Lipid metabolism represents an area of intensive interest and needs have been typically met by the use of physical mixtures of different fatty acids according to the chain length and the number and position of unsaturated bonds.

Research in nutritional medicine is focused on the composition of nutrient to support some metabolic needs in a special clinical situation involving special dietary purposes; *e.g.* malnutrition and respiratory distress syndrome.

## EXPERIMENTAL

The study was performed with three different diets which were applied by enteral feeding of male albino rats of the Fischer strain during a 14-day study period. Composition of medium chain triacylglycerols (MCTD), low fat (LFD) and control diet (CD) have been described previously.[5,6] The standard rat chow was used as control diet. All three diets were isoenergetic – MCTD 16.2, LFD 15.9 and CD 15.4 kJ/g. After a 14-day regime, the animals were sacrificed, and the lung was readily removed and submitted to the standard procedure. The total lipids were isolated from the lung and extracted according to the method of Folch *et al.*[7] The isolation of total lipids and their separation into individual lipid classes was done by procedures described previously.[8] Complex lipids were hydrolyzed by alkaline and acid hydrolysis, also as described previously.[6] The fatty acid composition was determined by gas chromatography on a Hewlett Packard gas chromatograph, Series 8500, equipped with a glass column, filled with 5% DEGS on Chromosorb b AW-DMCS (100 mesh). Column temp. 190 °C, carrier gas – nitrogen.

Fatty acid methyl esters were identified by comparison with the standards (Supelco , Gland, Swiss, Sigma Chem. Co. USA).

## RESULTS AND DISCUSSION

The physiological role of the lung depends on phosphatidyl-choline, the major phospholipid in the lung surfactant. Pulmonary surfactant is a complex of lipids and proteins which lines the interior of the lung.[11] The fatty acid composition of the polar and neutral surfactant lipids can be changed by nutritional intake. The role of phosphatidylcholine in the formation of pulmonary tensides as well as the role of this compound in the laboratory diagnosis of the respiratory distress syndrome are well known.[12]

This experiment focused on the metabolic effects and health benefits to specific lipid families according to the amount and quality of fat (length of the fatty acid chain and the number and position of double bonds), carbohydrates and proteins in the applied diets, namely MCTD and LFD.

TABLE I

Percent of differences (in %) in rat lung fatty acids in the application of the low fat diet (LFD) and medium-chain triacylglycerols diet (MCTD)

| Fatty acid | Differ. between LFD and CD (%) | | | Differ. between MCTD and CD (%) | | |
|---|---|---|---|---|---|---|
| | PC | PL | NL | PC | PL | NL |
| $C_{16:0}$ | − 5.3 | − 11.0 | + 4.2 | + 152.6 | + 39.5 | + 70.0 |
| $C_{16:1}$ | + 87.2 | + 111.5 | + 27.0 | − 64.6 | − 56.5 | − 59.6 |
| $C_{18:0}$ | 0.0 | − 31.4 | − 11.9 | − 21.1 | + 142.0 | + 483.9 |
| $C_{18:1}$ | + 9.7 | + 21.4 | + 14.3 | − 80.7 | − 35.7 | − 91.1 |
| $C_{18:2}$ | 0.0 | − | − 43.4 | + 283.0 | − 59.8 | − 99.4 |
| $C_{18:3}$ | − 70.0 | 0.0 | + 75.4 | − 56.0 | − 80.3 | − 87.4 |

Legend: PC – phosphatidyl-choline, PL – polar lipids, NL – neutral lipids

The effect of MCTD and LFD on the fatty acid content in neutral lipids, polar lipids and especially in the phosphatidylcholine fraction in comparison with CD is shown in Table I. The obtained data show that using MCTD, the percent proportion of palmitic acid was increased.

The effect of MCTs preparation on the lung phospho- and neutral lipids is manifested as a change in the degree of saturation -expressed as a ratio of saturation index ($RS_i$) MCTD vs CD (Table II).

The results on the fatty acid composition of lipids obtained by using LFD showed the effect on desaturation in both $C_{16}$ and $C_{18}$ fatty acids (Table I). The desaturation effect by LFD application was focused exclusively on the phosphatidylcholine fraction. The fatty acid composition of phosphatidylcholine showed desaturation, expressed as the ratio of desaturation index $RD_i$ of $C_{16}$ fatty acids of LFD *vs.* CD. The $RD_i$ was 1.95, which was a 95% increase of desaturation in LFD fed animals as compared to the control group.

TABLE II

Ratio of desaturation and saturation index of rat lung fatty acids in the application of the low fat diet (LFD) and medium-chain triacylglycerols diet (MCTD)

| | LFD | | MCTD | |
|---|---|---|---|---|
| | $RD_i16$ | $RD_i18$ | $RS_i16$ | $RD_i18$ |
| Phosphatidyl-choline | 1.95 | 0.74 | 6.90 | 3.42 |
| Polar lipids | 2.50 | 1.05 | 3.30 | 6.33 |
| Neutral lipids | 1.28 | 1.17 | 11.60 | 9.43 |

Legend: $RD_i16(18)$ ratio of $D_i$ ($C_{16}$ or $C_{18}$) of LFD *vs.* CD, $RD_i16(18)$ ratio of $D_i$ ($C_{16}$ or $C_{18}$) of MCTD *vs.* CD

The observed effect on desaturation was a consequence of administration of LFD, which contains lower amounts of essential fatty acids, which strongly affects the conversion of palmitic acid into palmitoleic acid. The LFD can be useful as a carbohydrate diet in a special clinical situation only if enriched with a basic amount of essential fatty acids, especially linoleic acid.

A positive effect of MCTs might, in principle, be useful as one of the ways of preventing the occurrence of the respiratory distress syndrome by favouring the biosynthesis of diplamitoyl-phosphatidylcholine.

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## SAŽETAK

### Utjecaj različitih dijeta na promjenu sastava masnih kiselina pluća

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Učinak dijeta s različitim sadržajem masti na sastav masnih kiselina pluća proučavan je na štakorima Fischer hranjenim s dvije pokusne polusintetske izokalorične dijete koje sadržavaju različit sastav masti: dijeta s niskim sadržajem masti (»low fat diet« LFD) i dijeta sa srednjelančanim triacilglicerolima (»medium-chain triacylglycerols diet« MCTD).

Učinak pripravka MCT na fosfo- i neutralne lipide pluća odražava se u promjeni stupnja zasićenosti, izraženog kao indeks zasićenosti (RSi) MCTD prema CD (kontrolna dijeta). Zasićenost se povećala u neutralnim lipidima za 70%, u fosfatidilkolinskoj frakciji za 152.6%, a u drugim fosfolipidima za 39.5%.

Podatci o sastavu masnih kiselina u lipidima, dobiveni korištenjem LFD, pokazali su da dolazi do nezasićenja izraženog kao indeks desaturacije (RDi) LFD prema CD, koji je u frakciji fosfatidilkolina bio 1.95.

Primijećena desaturacija posljedica je primijenjene LFD, koja sadržava manju količinu nužnih masnih kiselina, što znatno utječe na pretvorbu palmitinske kiseline u palmitooleinsku kiselinu. LFD bi mogla biti korisna kao ugljikohidratna dijeta u posebnim kliničkim slučajevima, samo ako se obogati nužnim masnim kiselinama, posebice linolenskom kiselinom.