FATTY ACID COMPOSITION AND CONTENT OF INDIVIDUAL LIPID FRACTIONS IN ADIPOSE AND MUSCLE TISSUES OF ALBINO RATS WITH ALLOXAN DIABETES

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Adipose tissue occupies the central place in the regulation of lipid metabolism [9]. The principal metabolic pathways in the fat cell, namely lipogenesis, lipolysis, etc., are controlled by a number of factors, including hormonal. For example, the entry of glucose into cells for lipogenesis is controlled by insulin [14], which has a coordinating influence also on the activity of several lipogenetic enzymes [15]. Insulin also regulates activity of the intracellular substrate cycle: triglycerides — fatty acids [8].

There is evidence in the literature of inhibition of fatty acid biosynthesis in adipose tissue of diabetic rats, of depression of the activity of enzyme reactions responsible for conversion of saturated fatty acids into monosaturated acids and the formation of linolenic acid from linoleic ($C_{18:2}$) — the initial stage of transition of $C_{18:2}$ into arachidonic acid ($C_{20:4}$), which limits the velocity of the process, and also of disturbances of the lipid and fatty-acid composition of adipose tissue [5-7, 10, 13].

The aim of this investigation was to study the fatty acid composition and content of triglycerides (TG), the fraction of polar lipids (PL), consisting mainly of phospholipids, and of nonesterified fatty acids (NEFA) of adipose and muscle tissue of albino rats with alloxan diabetes.

EXPERIMENTAL METHOD

Diabetes was induced in albino rats by the method described previously [2]. Fractions of neutral and polar lipids were isolated by column chromatography on silica-gel (L 40-100, Czechoslovakia). The fraction of neutral lipids was subjected to further fractionation on a column with silica-gel [4, 12]. Gas—liquid chromatography (Pye Unicam) of methylesters of fatty acids was carried out on 1200 × 3 columns with 8% polyethylene glycol adipate (PEGA) and 3% SE-30 on Gas Chrom Q, under isothermic (180°C) and gradient (170-240°C) temperature conditions. Nervonic and lignoceric acids were used for quantitative calculation of the lipid fractions.

EXPERIMENTAL RESULTS

The results of a study of the fatty acid composition of the lipid fractions of adipose tissue of normal rats and rats with alloxan diabetes are given in Table 1. In diabetes there was a marked fall in NEFA concentration in the adipose tissue (by 73%), evidently due to their increased mobilization into the blood stream, as is confirmed by data in the literature on diabetic patients [14] and also the results of our previous investigations in experimental diabetes [3]. Increased mobilization of fatty acids from adipose tissue is known to be accompanied by an increase in the rate of their oxidation in muscles [9], and in all probability this may explain the fall in the NEFA concentration observed in muscle tissue of diabetic animals (by 67%) in the present experiments. As Table 2 shows, definite changes in fatty acid composition were present under these circumstances.

In alloxan diabetes a decrease in the TG content by 76 and 62% was found in both adipose and muscle tissue respectively of the rats, in agreement with data in the literature [7]. A

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TABLE 1. Fatty Acid Composition (in %) of Lipid Fractions of Adipose Tissue of Albino Rats with Alloxan Diabetes (M ± m)

Fatty acid	NEFA		TG		PL	
	control	diabetes	control	diabetes	control	diabetes
16	10,9±2,2	16,9±2,7	4,1±0,4	5,6±0,9	4,0±1,5	4,2±0,7
16:0	44,3±2,7	41,7±4,5	44,1±2,2	35,8±1,8*	24,3±1,9	26,2±3,6
16:1	2,8±1,1	—	4,0±1,0	1,2±0,9*	2,3±0,8	1,2±1,0
18:0	9,3±1,3	11,4±2,0	9,4±1,3	15,3±2,3*	13,2±1,9	11,0±2,6
18:1	30,3±2,2	33,5±3,6	25,2±1,6	18,0±1,9*	43,4±1,9	40,5±3,7
18:2	3,0±0,9	—	14,4±1,3	24,1±1,0*	4,7±1,2	4,9±1,3
20:4	—	—	—	—	6,2±1,1	4,1±0,3

Legend. Mean values of 8-9 determinations given. Here and in Table 2: *P < 0.05 compared with control.

TABLE 2. Fatty Acid Composition (in %) of Lipid Fractions of Muscle Tissue of Albino Rats with Alloxan Diabetes (M ± m)

Fatty acid	NEFA		TG		PL	
	control	diabetes	control	diabetes	control	diabetes
16	9,4±4,5	10,4±2,8	7,2±1,6	9,3±1,7	1,8±1,0	7,0±1,7*
16:0	30,4±3,5	25,6±3,0	31,0±2,4	37,8±1,7*	18,1±3,6	22,5±1,8
16:1	13,2±1,4	10,2±1,8	13,6±1,3	0,9±1,2*	2,0±0,9	4,8±1,2
18:0	10,9±0,5	14,2±5,0	10,0±1,1	9,7±1,3	27,4±2,5	18,9±3,0*
18:1	28,6±2,1	27,1±2,9	28,2±2,3	35,2±2,1*	19,4±1,8	15,6±3,7
18:2	3,0±1,1	10,0±1,7*	10,7±1,1	7,2±1,4	14,7±1,2	22,5±2,1*
20:4	1,5±0,2	2,5±1,0	—	—	16,0±1,4	11,7±2,1

Legend. Mean values of 6-7 determinations shown.

decrease in the relative content of palmitic, palmito-oleic, and oleic ($C_{18:1}$) acids and an increase in the stearic acid level ($C_{18:0}$ and $C_{18:2}$) was observed in the fatty acid composition of TG in adipose tissue (Table 1). The increase in the content of $C_{18:0}$ and a decrease in that of $C_{18:1}$ are in agreement with data described in [10], the authors of which found a decrease in Δ9-desaturase activity in the adipose tissue of albino rats with alloxan diabetes. The same workers [10] found inhibition of Δ6-desaturase activity in diabetes, which went some way toward explaining the increase in the relative percentage of $C_{18:2}$ in the composition of TG in adipose tissue. A marked increase in the $C_{18:2}$ content also was found in PL fraction of muscle tissue of rats with alloxan diabetes (Table 2). Changes in the $C_{18:2}$ content deserve particular attention because of information in the literature [11] on the specific role of $C_{18:2}$ in metabolic conversions in diabetes and its possible use for the treatment of such patients.

Some decrease in the relative content of $C_{20:4}$ was found in the present experiments in the PL fraction of these tissues. Similar changes were described by the writers previously in the composition of most individual phospholipids of the liver and PL of the blood [1, 3].

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