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COMPARISON OF FATTY ACID COMPOSITION OF HUMAN ADIPOSE TISSUE IN SUPERFICIAL AND DEEP SITE*

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The fatty acid compositions of 18 samples of human adipose tissue taken from the anterior abdominal wall have been compared with those of deeper (pericardial) site samples from the same individuals. The saturated acids, 16:0 and 18:0 are present in significantly higher percentage amounts on pericardial tissue, this increase being accompanied by significant decreases in (a) odd-numbered and branched-chain acids, and (b) C_{10} to C_{14} even-numbered saturated acids. The percentage trans-unsaturated acids is somewhat lower at the deeper site, but the difference is not statistically significant.

Key words: Adipose tissue, Fatty acids, Trans acids.

INTRODUCTION

There have been many studies on the effect of sample site on human adipose fatty acid composition, and when conducted on thinly insulated extremities, the results would appear to be unambiguous. Thus material from the arm, and particularly from hand and foot,was shown by Imaichi *et al.* [1] to be persistently lower in saturated acids 14:0, 16:0 and 18:0 than samples taken from abdominal wall or mesentry. This decrease was accompanied by an increase in 14:1 and, particularly, in 16:1; there was however no discernable increase in 18:2, nor within the limits of experimental error, in the major component 18:1.

Comparisons of subcutaneous samples – other than from exposed sites – with material from deeper site, however, are not often in agreement and are somewhat fragmental. Thus Pietropaolo *et al.* [2] for example found no significant differences between abdominal, omental, perinephric and mesenteric tissue. Whereas Hirsch *et al.* [3] reported slight differences, deeper site fat being somewhat more saturated. Later, however, Hirsch *et. al.* [4] regarded the difference as "questionable and probably insignificant".

Differences similar to those observed by Imaichi *et al.* have been reported in animal models. Thus Duncan *et al.* [5] found consistently lower amounts of saturated C_{14} to C_{18} acids on leg and ear tissues of the sheep, but also (less markedly) on rump and chest, than at deep site. It was also found that superficial site material was lower not only in main-component even-numbered saturated acids, but also in the odd-numbered and branched-chain 15:0 and 17:0 acids.

The higher unsaturation at superficial and exposed sites is generally believed to be due to the necessity of maintaining proper melting-point and cell-membrane fluidity.

Neither Imaichi *et al.* nor Duncan *et al.* studied pericardial tissue fat.

In a series of papers [6-8] we have found that trans acids characteristic of commercially-hydrogenated fat are present in abdominal adipose tissue samples of persons dying of ischaemic heart disease (cases) in higher amount that in specimens from persons dying of unrelated causes (controls). Conversely, odd-number and branched-chain acids (14:1, 15:0 15:0 br., 15:1, 16:0 br., 17:0, 17:1 – collectively labelled L, 14:1 being included purely on account of difficulty in separating from 15:0 br.) characteristic of ruminant-animal fat, were found at higher concentration in the control samples. Inlight of these facts, it has been thought prudent to compare the compositions of a selection of such samples taken at abdominal site with those taken at deep site from the same persons – and choice of pericardial site would appear to be appropriate.

EXPERIMENTAL

Tissue sample selection and general methods were as previsouly outlined [6]. In the G.L.C. work, analyses reported below were derived using the one column (EGSS-Y) only.

RESULTS AND DISCUSSION

Samples of pericardial fat from 18 male subjects have been analysed in respect of fatty acid compositions and

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contents of trans-unsaturated acids, and the results compared with the compositions of abdominal samples from the same individuals. The mean compositions of the two sets are given in columns 2 and 3 of Table 1.

The most obvious difference between the two averages is in respect of acids 16:0 and 18:0, both of which are present – as may have been expected for deeper site tissue – in higher percentage on the pericardium samples. The mean values of the 18 differences (column 4; pericardial minus abdominal) are 2.39% for 16:0 and 1.38% for 18:0, and the corresponding standard deviations of the differences are 1.463 and 1.062. Student's "t" values are therefore 6.93 and 5.51 respectively showing that both differences are highly significant ($p \ll 0.001$).

With the exception of 18:1 which is alittle higher on pericardium, the differences for all other components pericardium minus abdominal – are negative (column 4). However, some decreases must occur to make up for the percentage increase in 16:0 plus 18:0. To make allowance for this the figures in column 5 were evaluated on the basis that the decreases are spread proportionately. Thus for one sample having 16:0 plus 18:0 = 6.81% on abdominal tissue, and 16:0 plus 18:0 = 33.30% on pericardial tissue, the "expected" pericardial value for 16:1 will be 6.81 multiplied by the factor (100-33.30)/100-28.44) i.e. 6.35%. The actual 16:1 pericardial percentage for this samples was 4.21, and the "adjusted" decrease is then 6.35% minus 4.21% – and so on for all 18 paired samples. The "adjusted" mean sample differences for the various fatty acids are recorded in the 5th column, their standard deviations in column 6 and the corresponding p values in the last column. It can be seen that whereas of course "adjusted" differences are smaller than before, they remain significant for the majority of the acids concerned.

The picture which emerges can now be summarised as below:

(a) To an extent, the high percentages of 16:0 and 18:0 on pericardium are accompanied by a (real) decrease in 16:1 – a result in agreement with the observations of Imaichi *et al*. Peculiarly however, main-component 18:1, which would have been expected to decrease to a mean value 41.68 % is actually somewhat higher (44.22 %)

Table 1. Mean fatty acid composition of 18 paired samples, abdominal versus pericardial site.

Acids	Mean % compositions		Mean difference pericardial - abdominal	"Adjusted" mean difference	Standard deviations of "adjusted" differences	P
	Abdominal	Pericardial				
10:0, 12:0	0.68	0.54	– 0.14	– 0.10	0.158	$\langle$ 0.05
14:0	3.97	3.48	– 0.49	– 0.29	0.405	$\langle$ 0.01
14:1, 15:0 br.	0.90	0.69	– 0.21	– 0.16	0.161	$\langle$ 0.001
15:0	0.68	0.45	– 0.23	– 0.19	0.193	$\langle$ 0.001
15:1, 16:0 br.	0.39	0.29	– 0.10	– 0.08	0.172	N.S.*
16:0	21.63	24.02	2.39			
16:1	7.96	6.81	– 1.15	– 0.74	1.170	$\langle$ 0.05
17:0 br.	0.65	0.61	– 0.04	– 0.01	0.223	N.S.
17:0	0.97	0.76	– 0.21	– 0.16	0.273	$\langle$ 0.05
17:1	1.04	0.78	– 0.26	– 0.21	0.285	$\langle$ 0.01
18:0	4.67	6.05	1.38			
18:1	43.93	44.22	0.29	2.54	1.725	$\ll$ 0.001
18:2	7.41	6.81	– 0.60	– 0.22	0.614	N.S.
18:3, 20:0	1.19	1.01				
20:1	1.94	1.91				
20:2, 20:3	0.81	0.68	– 0.63	– 0.37	1.033	N.S.
22:0, 20:4	0.39	0.36				
22:1	0.79	0.53				
Trans acids	5.38	5.01	– .37	– .09		N.S.

* Not significant

on pericardium, the difference (2.54) being highly significant. This result supports the view of Geto *et al.* [9] that the solidity of depot fat is determined by amounts of 16:0, 18:0 and 16:1 and not by the amount 18:1.

(b) Odd-number and branched-chain acids are present at the deeper site in significantly lower concentration, and the same is true of even-number C_{10} to C_{14} acids. All these acids are present in dairy and ruminant-animal fat in high proportion, but are virtuaually absent in most vegetable oils – with the exception of coconut and palm-kernel.

What physiological conclusion may be attached to this observation we do not know; it may be, however, that heart muscule is able to directly mobilise such acids from pericardium site more readily than the higher even-numbered C_{16} and C_{18} straight-chain acids.

(c) Rather expectedly perhaps, the adjusted percentage 18:2 on pericardium is only a little lower than on abdominal tissue, and the difference is not significant (compare Imaichi *et al.* above).

(e) The percentage of trans acids in the 18 samples range from Ca. 3 to 10%, and that of L acids from 1-5%. Correlation between trans acids contents at the two sites is very strong (Spearman rank coefficent, $r_s = 0.889$, $p = 0.001$) and therefore the differences in trans levels observed between our case and control samles are not due to fortuitious choice of sample site. Similarly there is a very strong correlation for L between the two sets ($r_s = 0.938$, $p \ll 0.001$).

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