INFLUENCE OF THE CARCASS LOCATION OF ADIPOSE TISSUE ON THE FATTY ACID COMPOSITION OF PORK FAT

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INTRODUCTION

It is well established that the carcass location of porcine adipose tissues has a considerable effect on the characteristics of pork fat. The cause for this is seen particularly in the tissue temperature which is higher and more constant inside the body then at its surface.

C l a r i c i n i (1) reported that with a pig body temperature (rectal temperature) of 39.9° C, the backfat tissue located 1 and 4 cm deep in the body had a temperature of 33.7 and 39.0° C, respectively. It is also well established that fat from tissues located deeper in the body has a higher melting point and a lower iodine value, and consequently also a higher content of saturated fatty acids, than fat near the surface of the body.

S t o j c e v (2), comparing the melting points of porcine fats from various tissues, arranged indivisual kinds of raw pork fat in order of their suitability with respect to the quality of lard. He recommended perinephric fat tissue with the highest malting point as the most suitable and considered subcutaneons adipose tissue to be the least satisfactory in this respect.

N a k o n e c n y j (3) found that the melting point of porcine backfat decreased while its iodine value increased in the direction from the neck towards the joint.

More recent investigations were concerned with the fatty acid composition of porcine fats. They include comparative studies on perinephric fat and backfat (M a s o n and S e w e l l - 4, B a r v i r et al. - 5) on inner and outer layers of porcine backfat (E l l i o t and B o w l a n d - 6, K o c h et al. - 7) and on depot and muscular fats (N i l s s o n and N o r e n - 8).

The present study was designed to elucidate the influence of the carcass location of the technologically most important porcine adipose tissues, namely, perinephric fat and backfat on the basic composition of adipose tissue and particularly on the fatty acid composition of pork fats.

MATERIALS AND METHODS

Pork fat samples were taken from two groups of slaughter pigs. In Group 1, determinations were made only of the basic composition of the tissue and of melting points and iodine values of the fat. The fat samples from Group 2 were in addition analysed for the composition of fatty acids.

Each group consisted of 12 Large White pigs (6 males and 6 females) from two litters. Both groups were fed on the same diet, receiving commercial feed mixtures up to 75 kg. body weight, and potatoes and barley and oat groats in the final fattening stage. Both groups were slaughtered at 6 and 1/2 months of age.

The mean preslaughter weight was 99 and 96 kg and the mean thickness of backfat was 31 and 30 mm, respectively, in Group 1 and 2.

The areas sampled in both groups of pigs were as follows:

(a) perinephric fat adjacent to the diaphragm;

(b) backfat above the 2nd thoracic vertebra;

(c) backfat above the 13th thoracic vertebra;

(d) backfat above the last lumbar vertebra;

Backfat samples taken above the 13th thoracic vertebra were separated into the inner and outer layers exactly in the middle and these two layers were then analysed separately.

ANALYTICAL METHODS

Homogenised adipose tissues samples were analysed for water content by drying at 105°C to constant weight and for fat content by the extraction method of Soxhlet using ethyl ether. The content of solids-not-fat was determined by computation.

Aliquots of fat samples were melted in beakers at 115° C under constant conditions. The melting point of the lard was obtained by determining the slipping point. The iodine value was determined according to Hanus.

Lard samples from Group 1 were saponified and methyl esters of fatty acids were then prepared by esterification with methanol in the presence of sulphuric acid.

The methyl esters of fatty acids were analysed in a CHROM 2 gas chromatograph of Czechoslovak origin equipped with a flame ionisation detector. Separation was achieved on a 2550 x 6 mm stainless column packed with 20 per cent polyethylen glycoladipate on Chromosorb W 60-100 mesh. The chromatography was carried out under the following conditions: column temperature, 195 °C; nitrogen, hydrogen and air flow rates, 35, 35 and 500 ml/min., respectively.

Qualitative analysis was performed by comparing the elution times with those of pure standards and on the basis of a linear relationship between the logarithm of elution times and the number of carbons in the homologous series of fatty acids. Quantitative analysis was performed by the method of the internal normal, and the peak area for each fatty acid was determined by approximation as an isosceles triangle (P u r n e l l - 9) .

RESULTS AND DISCUSSION

The data obtained for the water, fat and solids-not-fat contents of adipose tissues in bot groups of pigs (Tables 1 and 2) show that perinephric fat tissue differs markedly from the backfat tissue by a lower content of water and solids-not-fat and by a higher content of fat. This implies that backfat contains more connective tissue as compared to perinephric fat. In the backfat tissue the water and solids-not-fat content, decrease steadily in the direction from the neck while the fat content undergoes a concurrent increase. Considerable differences in these values were found between the inner and outer layers of backfat, with the former containing more fat and less water and solids-not-fat than the latter.

The melting point and iodine values of pork fat (Table 1 and 2) showed marked differences between the perinephric fat and backfat as well as between the inner and outer layers of backfat. The higher melting points and lower iodine values obtained for perinephric fat and inner backfat indicate a higher proportion of saturated fatty acids in these fats which is in keeping with the results obtained by S t o y c e v (2). Contrary to data reported by Nakonecnyj (3), our melting point and iodine values did not show a uniform pattern of change in the direction from the neck towards the joint. Though differing slightly between the two groups, they exhibited only little change within the group. This would imply that the ratio of saturated and unsaturated fatty acids in backfat is also more or less constant.

Total content of saturated fatty acids (Table 3) was approximately 10 per cent higher in perinephric fat than in backfat, with the ratio of saturated and unsaturated fatty acids of the perinephric fat being 0.83. The same ratio of saturated and unsaturated fatty acids was also obtained for backfat samples taken above the 2nd and 13th thoracic vertebrae but not for those taken above the last lumbar vertebra where the proportion of unsaturated fatty acids was 1.5 per cent higher.

In the present study, total content of saturated fatty acids was 3.5. per cent higher in inner than in outer backfat which is in reasonable agreement with the 3.29 per cent difference reported by K o c h et al.(7).

Data for individual fatty acids of pork fat as reported by M a s o n and S e w e l l (4), B a r v i r et al. (5), E l l i o t and B o w l a n d (6) and K o c h et al.(7) show some relatively considerable differences which can be accounted for by differences in the pigs diet, by fat collection from different areas and by use of different analytical methods. It is therefore preferable to compare differences rather than absolute values. In view of the possible causes of different absolute values for the the content of individual fatty acids it seems reasonable to claim satisfactory agreement between our results and those reported by other writers. It should be noted, however, that this agreement was more marked with regard to differences in the content of individual fatty acids between inner and outer backfat than with regard to those found between perinephric fat and backfat. This can, no doubt, be accounted for by differences in the carcass location of fat specimens, particulary with backfat.

The proportions of both major saturated fatty acids, namely, palmitic and stearic acid were maredly higher in perinephric fat and inner backfat as compared to backfat and its outer layer. Unequivocal differences were also found in the content of major unsaturated fatty acids, namely, palmitooleic, oleic, linoleic,and eicosenic acid. The proportions of the remaining fatty acids showed no substantial differences.

The backfat exhibited a steady decrease in the proportion of palmitic acid and a steady increase in the proportion of oleic and eicosenic acid in the direction from the neck towards the joint. Values for other fatty acids contained in the backfat were either practically unchanged showing no dependence on carcass location of the tissue or exhibited only slight differences without a consistent pattern of change.

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Table 1

Basic composition of adipose tissue and basic characteristics of pork fats at various carcass location in Group 1

Area sampled	Water (%)	Fat (%)	Solids-not-fat (%)	Melting point (C°)	Iodine value (according to to Hanus)
Perinephric fat adjacent to the diaphragm	4.75	93.61	1.64	43.2	49.8
Backfat above the 2nd thoracic vertebra	9.03	87.78	3.06	35.3	55.1
Backfat above the 13th thoracic vertebra	8.66	88.70	2.64	34.8	59.0
Backfat above the last lumbar vertebra	6.60	91.75	1.56	35.0	56.8
Backfat above the 13th thoracic vertebra					
inner layer	*7.10*	*90.90*	*1.93*	*37.6*	*57.1*
outer layer	*10.23*	*86.40*	*3.35*	*32.0*	*60.9*

Table 2

Basic composition of adipose tissue and basic characteristics of pork fats at various carcass location in Group 2

Area samples	Water (%)	Fat (%)	Solid-not-fat (%)	Melting point (C°)	Iodine value (according to Hanus)
Perinephric fat adjacent to the diaphragm	3.42	94.70	1.91	44.0	49.7
Backfat above the 2nd thoracic vertebra	8.96	87.40	3.67	32.8	61.2
Backfat above the 13th thoracic vertebra	7.70	89.45	2.81	32.0	58.0
Backfat above the last lumbar vertebra	6.30	91.65	2.00	30.7	60.2
Backfat above the 13th thoracic vertebra					
inner layer	6.68	90.90	2.34	34.4	55.6
outer layer	8.73	88.00	3.28	29.7	60.4

Table 3

Percent fatty acid composition of pork fats at various carcass locations in Group 2

Fatty acid	Perinephric fat adjacent to the diaphragm	Backfat			Backfat above the 13th thoracic vertebra	
		above the 2nd thoracic vertebra	above the 13 th thoracic vertebra	above the last lumbar vertebra	Inner layer	Outer layer
10 : 0	0.1	0.1	0.1	0.1	0.1	0.1
12 : 0	0.1	0.1	0.1	0.1	0.1	0.1
14 : 0	1.4	1.5	1.3	1.3	1.3	1.3
15 : 0	0.1	0.1	0.1	0.1	0.1	0.1
16 : 0	26.6	24.0	23.6	22.9	24.7	22.4
16 : 1	1.6	2.0	2.0	2.0	1.7	2.4
17 : 0	0.3	0.3	0.3	0.3	0.3	0.3
17 : 1	0.2	0.4	0.3	0.4	0.3	0.4
18 : 0	22.0	15.2	15.7	14.8	16.4	15.7
18 : 1	42.3	48.8	49.7	50.8	48.7	50.7
18 : 2	3.8	5.8	4.8	5.1	4.4	5.2
18 : 3	0.3	0.4	0.4	0.3	0.3	0.4
19 : 0	0.3	0.1	0.1	0.1	0.1	0.1
20: 0	0.2	0.2	0.2	0.3	0.3	0.2
20 : 1	1.0	1.3	1.5	1.6	1.4	1.6
Total saturated acids	*50.8*	*41.3*	*41.3*	*39.7*	*43.2*	*39.3*
Total unsaturated acids	*49.2*	*58.7*	*58.7*	*60.3*	*56.8*	*60.7*

Explanatory notes: 10 : 0 ... saturated fatty acid with 10 carbon atoms (capric acid);
18 : 1 ... unsaturated fatty acid with 18 carbon atoms and one double bond (oleic acid)