HYDROCARBON CONTENT OF NEUTRAL LIPID FRACTIONS OF DIFFERENT HOG AND CATTLE TISSUES

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INTRODUCTION

The role of lipids in living organisms has been considerably investigated and there are numerous data on their importance in nutrition.
The attention was concentrated, in the last years on the investigation of cholesterol and other microcomponent co - nstituents in food and the forms in which they can be found, as well as on identification of undesired changes in lipids which could occur during food processing and storage (1),(2),(3). Data were reported resently about the fatty acid compositions (4) and the cholesterol contents in hog and cattle tissues (4)(5)

There are, however, limited data about the hydrocarbon contents and compositions in various animal tisues (6),(7),(8). There is no doubt about the conection between hydrocarbons and the biochemical and physiological changes in tissues. The amount of hydrocarbons in the muscle tissue of cattle ranges from 4o-5o mg/kg to loo mg/kg (6). Althoug their content is not high, their role is significant in the organism development. This is especially true for squalene which appears as a precursor in the biosynthesis of animal cholesterol or plant sterols (7),(9).Dihydrosqualene and tetrahidrosgualene were also found in the muscle tissue of cattle (8).

A significant role in premortal and postmortal changes in meat is played by olefins. Their double bond could oxidized rapidly and therefore an increased amount of them is always unfavorable. According to the results of some authors (6),(8) mono-,di- and tri- unsaturated olefins were identified and their contents amounted to 3o-5o% of the total hydrocarbons found in the muscle tissue of cattle. The most numerous were tri- unsaturated olefins, while monounsaturated olefins were presented only in traces (8).

It is characteristic for all n-alkanes present in living sistems thet they transform to carbonic acids which could be reversly transformed to n-alkanes by decarboxylation.

Besides n-alkanes the muscle tissue of cattle also contains cycloalkanes (8). Ih the cattle intramuscular lipids traces of monocyclic arenes were also found (8).

MATERIALS AND METHODS

The muscle tissue M.Longissimus dorsi in the region of the 12^{th}-14^{th} vertebra as well as liver, fatty tissue, brain and spinal cord of five large white hogs of carcass mass about 81 kg, were taken from the slaughter line and immediately studied.

The Muscle tissue, livers, fatty tissues, brain and spinal cords of five Simmental cattle weighting about 4oo kg and 18 months old were taken from the slaughter line.
All the tissues were sealed in PE bags and held at -3o°C until further processing.
The total lipids were extracted by procedure according to Folch ef al (1o). The lipid fractions were fractionated on a Silica Gel 6o (7o-23o mesh) column to neutral lipids, glycolipids and phospolipids according to the procedure described by Johnston (11). Mass content of fractions were determined after the evaporation of solvent in a nitrogen gas stream and expressed as percent of total lipids.

The neutral lipids were separated by column chromatography (Florisil loo-2oo mesh) according to the procedure by Johnston et al (11) into the following fractions: hydrocarbons, cholesterol esters, triglycerides, cholesterol, diglycerides, monoglycerides and free fatty acids.Their mass content was determined and expressed as percent of total lipids.

The purity and identity of each fraction were determined by thin layer chromatografphy using Silica Gel G,and comparing the obtained R_f values with standards developed under the same conditions.
The quantitative analysis of hydrocarbons were performed on a Varian 3400 capillary gas chromatograph (SE 54 fused Silica capillary stationary phase on deactivated siloxane, column lenght 25 m, inner diameter 0,25 mm) with a FID detector.

Nitrogen was used as a carrier gas with flow rate 1.18 ml/min. Injector and detector temperatures were 250° and 300°, respectively. The analysis were performed at heating rate of 4°/min (130°-290°C). C_{10}-C_{35} n-paraffins and squalene were used as identification standards.

Components were identified on a Varian Gc 3700-MS 311-A GC-MS-C combination by comparison of the obtained mass spectra and the mass spectra of standards.

The solvents used in the preparation of samples were washed and dried in the usual way (12) and finally destilled through a 600 mm x 8 mm column with "Heli-pak" packing.

RESULTS AND DISCUSSION

The results presented in Table 1 show the content of hydrocarbons in the various hog and cattle tissues. Moreover, the content of hydrocarbons in the varions hog tissues already published in literature (5) is given in Table 1, also, for the purpose of comparation.

The content of n-paraffins and squalene in the neutral lipid fractions of hog a cattle tissue are given in Table 2. The C-atoms range in all samples was practically the same i.e. from C_{13} till C_{38} and the C- atom numbers showed a Gaussian distribution with C_{25}, C_{26} and C_{27} of the maximum, except in the cases of the hog and cattle fatty tissue. The hydrocarbon fractions originated from the fatty tissues showed unregular distributions with a relatively high ratio of odd to even n-paraffins (CPI) very simular to the resently publisted data on the n-paraffin distribution in the hydrocarbon fractions of castrate and boar intramuscular (M.Semimembranosus) lipids (13). The hydrocarbon fraction obtained from the hog fatty tissue showed an exceptionally high content of C_{16} n-paraffin and the hydrocarbon fraction obtained from the cattle fatty tissue showed a relatively large quantitie of C_{13}-C_{20} n-paraffins.

In all of the investigated hydrocarbon fractions isoprenoidal polyolefins, diterpene and triterpene hydrocarbons, iso-, anteiso- and other branched hydrocarbons were not found in such quantities requiring their complete identification.

Squalene was found only in the hydrocarbons originating from hog muscle tissue, hog liver and brain but not as a dominating component, as it was in the case of castrate and boar intramuscular lipids (13).

Table 1. Content of hydrocarbons in the hog and cattle tissues

	Muscle tissue			Liver			Fatty tissue			Brain			Spinal cord		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Cattle Hydrocarbon	1.98	1.48	0.04	4.57	1.08	0.04	0.56	0.54	0.49	3.76	1.30	0.12	29.52	7.33	1.54
Hog(5) Hydrocarbon	2.01	1.50	0.04	7.08	2.20	0.08	0.45	0.45	0.39	1.46	0.83	0.04	2.69	1.05	0.21

A- % of neutral lipids; B- % of total lipids; C-g/100 gr tissue

Table 2. Contents of n-Paraffins and Squalene in the Neutral Lipid Fractions of Hog and Cattle Tissues+

Tissue	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	Squalene	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{34}	C_{35}	C_{36}	C_{37}	C_{38}
Hog																											
Muscle tissue				0.5	0.6	0.8	1.0	1.2	1.7	1.8	2.0	3.6	5.9	6.4	5.1	4.7	3.4	5.2	4.8	2.5	1.0	0.8					
Liver						0.5	0.3	0.6	0.6	1.5	4.3	7.2	7.7	8.9	7.6	6.5	7.0	4.9	3.3	3.4	2.4	1.6	0.8				
Fatty tissue				8.4	2.1	1.9	0.7	1.2	1.3	1.7	3.9	6.1	8.6	8.8	5.0	3.7	-	2.4	2.7	3.4	2.3	1.2	1.0	0.8	0.6		
Brain					0.6	0.4	0.5	0.5	0.6	1.4	2.5	5.0	8.6	10.6	10.4	8.8	0.7	8.6	6.0	4.4	3.0	2.0	1.4	1.0	0.7	0.3	
Spinal cord	tr	tr	tr	0.2	0.3	0.3	0.35	0.4	0.6	0.8	2.0	3.9	4.8	5.2	4.7	4.0	-	4.0	3.5	3.4	1.3	0.8	0.8	0.7	0.5	0.4	0.2
cattle																											
Muscle tissue						0.2	0.2	0.25	0.3	0.8	1.7	3.3	4.4	5.2	3.2	3.4	-	3.0	2.8	2.5	1.8	1.7	1.4	1.2	0.9	0.4	
Liver						0.1	0.2	0.6	0.4	1.3	2.4	5.0	8.9	7.3	3.8	3.4	-	3.8	3.1	3.2	1.1	1.0	0.5				
Fatty tissue	0.7	1.9	0.8	1.8	1.4	2.8	2.4	2.7	0.4	1.9	2.8	3.0	3.4	4.3	3.2	2.7	-	2.9	1.7	2.1	1.6	0.8					
Brain					tr	0.1	0.15	0.18	0.2	0.7	1.9	2.8	4.2	4.6	4.6	4.0	-	4.0	3.2	3.1	3.0	2.7	1.2	0.6			
Spinal cord		0.05	0.06	0.07	0.08	0.1	0.2	0.6	1.5	2.0	3.6	4.0	4.3	5.5	5.4	5.2	-	5.1	4.2	4.4	4.0	3.8	2.2	1.7	0.9		

+ Values shown in Table represent percentages of total GC area of hydrocarbon fraction.

CONCLUSION

The distribution of n-paraffins in the hog muscle tissue is oriented towards smaller paraffins with the maximum at C_{26}, contrary to the distribution of n-paraffins in the cattle muscle tissue were C_{16} and C_{17} n-paraffins were not found. C_{34}–C_{38} n-paraffins were detected in the cattle muscle tissue, the major n-paraffin of which had 26 C-atoms.

The total content of hydrocarbons in the hog liver was two times higher than in the cattle liver. Liver samples showed simular n-paraffin distribution.

The fatty tissue showed the lowest hydrocarbon contents but the most complex compositions. Their GC-chromatograms showed numerous microcomponents especially between the C_{15} and C_{23} n-paraffin peaks.

The total content of hydrocarbons in the cattle brain was three times higher than in the hog brain. Another great difference between two brain samples was that the content of n-paraffins was two times higher in the hog than in the cattle sample.

The hydrocarbon fraction of the hog spinal cord did not contain C_{14}, C_{15} and C_{34}–C_{36} n-paraffins which were detected in the cattle spinal cord, but the total n-paraffin content was the same in both samples.

The obtained results showed the complexity of the hydrocarbon fraction in different hog and cattle tissues. The smollest quantity of n-paraffins was in the case of the cattle muscle tissue and the largest one in the case of the hog brain sample. All hydrocarbon samples, except the sample originated from the spinal cord, showed considerable higher contents of n-paraffins in the hog than in the cattle tissue.

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