The composition of pork lard as a raw material in meat production

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Abstract

The quality of pork lard is closely related to several factors that affect the composition of fatty acids and therefore has a direct impact on the technological properties of the lard, especially the formation of soft lard, and causes problems during the production of dried sausages. A methodology of sampling lard from suppliers was developed, so that the measured values of fat composition represented an average value for an entire batch. Gas chromatography was applied to determine the composition of pork adipose tissue, and the data obtained was further evaluated using HP Chemstation. The final development procedure of adipose tissue sampling enables to evaluate the quality of pork lard imported from various parts of Europe. The content of unsaturated fatty acids exceeded 60%, whereas the content of polyunsaturated fatty acids ranged from 10% to 16%. These relatively high values may, however, cause severe problems in the production of durable sausages.

Lard, fatty acids, unsaturated, quality

Introduction

The adipose tissue of pigs, raw pork lard, plays an essential role in meat production. The traditional Czech sausage cannot do without it, for it is present in Gothaj and Mortadella sausages, and is essential in forming the “mosaic” pattern in durable sausages. All these products require firm lard that can be easily cut into neat cubes, and does not spread, and melt at low temperatures or even during grinding. Its viscosity is associated with the composition of fatty acids bound to glycerol in the fat. The more double bonds these acids have, i.e. the less saturated they are, the softer the consistency of the fat and the less suitable it becomes for meat products. This requirement, however, is in complete contrast to that proposed by nutritionists, who emphasize the positive nutritional significance of unsaturated fats, particularly fatty acids with several unsaturated bonds (polyunsaturated fatty acids - PUFA) (Pánek et al. 2002). In addition vegetable fats (oils, not margarines) tend to be even more unsaturated, and along with this fact a common generalisation can be made (which is not always justified), that vegetable fats are more healthy than animal fats, whose excessive consumption seems to be unhealthy.

The quality of pork lard has been changing during the recent decades as a result of changing feeding habits, the composition of animal feeds, breed diversity, animal age and other factors. The trend has been towards the occurrence of soft fat that causes great problems in the production of meat products, particularly durable sausages. The firmness of the adipose tissue depends on the unsaturated fatty acids content, which has been increasing in view of the factors given above (Franco et al. 2006; Wood et al. 2008). Moreover, the composition of adipose tissue also differs from individual parts of the carcass or categories of pork meat. Furthermore, adipose tissue its self or as a component of individual carcass parts is imported from various suppliers located in different climatic regions. Therefore, its composition and technological properties may, logically differ from each supplier. However, it is obviously not possible to test each individual piece of tissue, but it is, rather, more important, to know the average values of each entire delivery batch.

From the technological point of view, pig adipose tissue is assigned to a number of categories for meat production. These individual categories do not only differ in terms of

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fat, protein and (perhaps) remnants of muscle tissue proportions, but they might also differ in their fatty acid composition. During our assessment of adipose tissue, we discovered that a various classification systems are used, and they too differ in details from each other. The original system (known as GEHA) distinguishes 11 categories of pork production meat S_1 – S_{11}, as given in a clear manner by Klíma and Budig (1993). The catalogue of the Czech Meat Processors' Association (Kolektiv 2004) states only 10 categories V_1 – V_{10}; the differences concern, unfortunately, just the adipose tissue. The details of classification of production meats used in individual concerns differ even further. The in-house classification used in the co-operating concern is based on the original GEHA classification, though translated to Czech as V_1 – V_{11}. The definitions of adipose tissue used for the following measurements relate to the parts defined precisely below.

The aim of the given work was to compare a number of types of production meat (or adipose tissue) used in meat production and to monitor the variability of composition of fatty acids between individual suppliers within the EU.

Materials and Methods

A methodology for the collection of samples was developed in co-operation with the company Masný průmysl Krásno, a.s. in such a way that the values of the measured composition of fat represented average values for an entire delivery batch, which means several tons of meat of a considerably non-homogenous composition. Samples of adipose tissue were taken from the whole delivery (truck) during the process of deboning, and were subsequently homogenised in a cutter directly at the production concern and a representative sample was sent for analysis to the Institute of Chemical Technology in Prague, where it was processed immediately after receipt. Samples classified as follows were analysed for the purposes of this experiment (categories taken from the original GEHA classification): V_8 – fat from the leg (outer side) without skin, V_9 – fatty cuts from the shoulder, V_{10} – soft fat from the flank.

The principal way of assessing the composition of the adipose tissue of pigs currently used is gas chromatography (e.g. Ficara et al. 2010), though the use of Raman spectra on-line is also being tried (Olsen et al. 2007). A representative sample of fat was taken from a supplied amount of homogenate by quartering (in three parallel determinations). The sample was further dissolved and methylated : the isolated fat was subjected to acid hydrolysis and the fatty acids released converted into volatile methyl esters, which were analyzed via gas chromatography. Identification and determination of fatty acids took place with the help of a gas chromatograph equipped with a flame ionisation detector (FID) under the following conditions: Column: DB WAX, 100 m x 0.25 mm I.D., 0.25 mm; Mobile phase: helium 0.6 ml/s; Flow rate: 40 ml/s; Injection volume: 1 ml; Detector: FID; Detector temperature: 300 °C; Injector temperature: 250 °C, split 1:1; Column temperature: programme 60 °C/2 min., 60 –250 °C, 10 °C/min., 250 °C/8 min.

Chromatograms were evaluated using HP Chemstation chromatography software. Fatty acids were identified by means of comparison of the retention times of fatty acid peaks with the retention times of peaks of a standard mixture of fatty acids (Supelco™37 Component FAME Mix). Concentrations of individual fatty acids with 8 to 20 carbon atoms were obtained in this way, and the overall proportions of saturated, unsaturated and polyunsaturated acids then calculated. An approximate calculation of the iodine value was also performed – on the basis of the known concentration of double bonds; the quantity of iodine that would be required for their saturation was calculated.

Averages, standard deviations and the statistical significance of variance were calculated from the measured values. Standard deviations are not given in view of the size of the tables; they are available from the authors.

Results and Discussion

An overview of the composition of fats was obtained that allows the manufacturer to select appropriate raw materials. The values measured for the composition of individual samples of adipose tissue can be seen in the following tables and figures.

Results show that the content of unsaturated fatty acids in the adipose tissue, obtained from the supplied meat, was relatively high. The total content of unsaturated fatty acids exceeded 60% (Figure 1). Although oleic acid predominated (around 45%), there was also a large proportion of linoleic acid, while the proportion of linolenic acid was also not negligible.

The average proportions of fatty acids, in the individual categories of adipose tissue studied, did not show to be statistically significant and were covered up by other factors. Especially

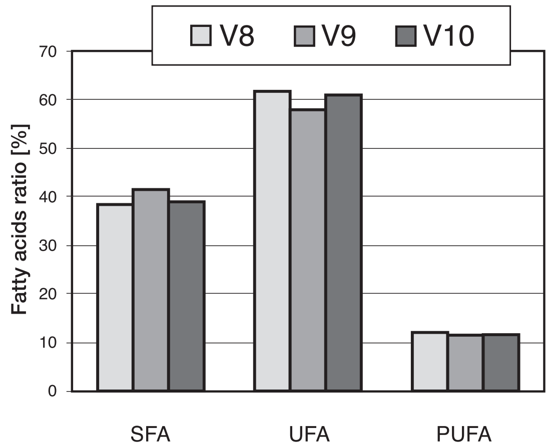

Fig. 1. Ratio of saturated (SFA), unsaturated (UFA) and polyunsaturated (PUFA) fatty acids in three categories of pork lard

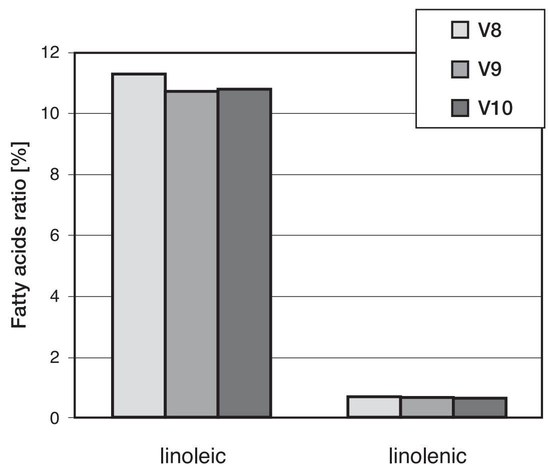

Fig. 2. Ratio of polyunsaturated (PUFA) fatty acids in individual categories of pork lard

the differences of linoleic acid content in each type of adipose tissue were quit small, and in the case of linolenic acid, they were entirely negligible (Figure 2). An approximate calculation of the iodine number was also performed to obtain a characterisation of the proportion of unsaturated bonds. The iodine number was calculated from the values of the measured proportions of unsaturated fatty acids (Table 3). Lower values were logically recorded for shoulder fat V_9, where there was also a lower total content of unsaturated fatty acids. Since both methods, gas chromatography and the determination of the iodine number, show similar results, it is worth considering, whether it is possible to use the old titration method as a simple operational alternative in cases when gas chromatography is not applicable or available.

Table 1. Proportions of saturated (SFA), unsaturated (UFA) and polyunsaturated (PUFA) fatty acids in adipose tissue from individual suppliers

Supplier	Country	SFA	UFA	PUFA
A	Belgium	37.58	62.22	13.42
B	Austria	37.51	61.61	10.10
C	Spain	38.49	61.51	11.68
D	Germany	38.70	61.28	11.61
E	Denmark	39.82	60.18	10.57
F	Denmark	39.98	60.13	9.37
G	France	38.74	59.97	13.41
H	Germany	40.67	59.47	9.91
I	France	40.55	59.45	12.53
J	Germany	40.62	59.26	10.81

Table 2. Proportions of individual fatty acids in adipose tissue from individual suppliers

Supplier	State	caprylic C 8	capric C 10	lauric C 12	myristic C 14	palmitic C 16	stearic C 18	arachic C 20	palmitoleic C 16-1	oleic C 18-1	linoleic C 18-2	linolenic C 18-3
A	Belgium	0.12	0.15	0.18	1.68	24.85	9.84	0.93	2.38	46.33	12.62	0.80
B	Austria	0.08	0.06	0.11	1.54	24.49	11.08	0.67	3.07	48.43	9.45	0.65
C	Spain	0.11	0.16	0.37	2.11	24.95	10.25	0.91	1.98	47.85	11.02	0.66
D	Germany	0.05	0.06	0.10	1.45	25.23	11.35	0.94	2.21	47.47	10.99	0.61
E	Denmark	0.07	0.08	0.07	1.36	25.45	12.26	0.68	2.82	46.79	9.87	0.70
F	Denmark	0.03	0.06	0.08	1.41	25.47	12.32	0.63	2.84	47.93	8.57	0.80
G	France	0.04	0.08	0.08	1.46	25.12	12.06		2.48	44.08	12.74	0.67
H	Germany	0.07	0.05	0.20	1.30	25.03	13.45	0.59	2.19	47.37	9.23	0.68
I	France	0.23	0.34	0.17	1.85	26.28	10.95	0.73	2.13	44.79	11.83	0.70
J	Germany		0.06	0.06	1.40	25.83	12.40	0.87	2.66	45.80	10.01	0.79

Table 3. Proportions of unsaturated fatty acids and iodine value – average for individual categories of fat

	palmitoleic C 16-1	oleic C 18-1	linoleic C 18-2	linolenic C 18-3	Iodine value
V8	2.35	47.26	11.26	0.74	55.77
V9	2.33	44.16	10.71	0.70	52.42
V10	2.58	46.76	10.77	0.67	55.04

Considering the factor of individual suppliers greater differences were found between the overall content of saturated and unsaturated fatty acids and the content of polyunsaturated acids, i.e. the linoleic and the linolenic acids (Table 1). It is, of course, impossible to identify the causes for these differences without data of intravital factors. It also proved impossible to demonstrate the effect of the geographic latitude of the country of origin, since the total proportions of all unsaturated fatty acids for the individual suppliers differed within a range of 4%. However, data collection and the selection of suitable suppliers are continuing.

In contrast, the content of linoleic acid varied within a range twice as large (Table 2), and reached even 16% for one supplier. Similar findings are given by Franco et al. (2006), though in contrast Hansen et al. (2004) found values considerably lower. The figures given in the literature vary considerably, however, depending on a number of factors.

Conclusions

Adipose tissue obtained by cutting it out from the meat supplied by a number of companies from various parts of Europe was evaluated using the method outlined above. The content of unsaturated fatty acids exceeded 60%, the proportion of polyunsaturated acids amounted to 10 – 16%. These high proportions may cause problems in meat production (the smudging of particles of adipose tissue during grinding, more difficult drying of durable sausages). Data collection and the selection of suitable suppliers are still continuing.

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