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OCCURRENCE OF EICOSADIENOIC ACID IN BEEF MEAT

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INTRODUCTION

The fatty acid composition of different animal species has been described by several authors (Schön, 1974; Freudenreich, 1983; Koch *et al.*, 1976; Loveday and Dikeman, 1980; Larick *et al.*, 1989) who studied genetic, nutritional and physiological influences in particular on the distribution of fats within the carcasses. The difference between beef and pork fat especially concerning the concentration of saturated and unsaturated fatty acids, is explained by the fact, that the fatty acid concentration in pork meat is mainly dominated by a direct resorption of fats from the feed stuffs whereas the fatty acid fraction of beef fat is mainly due to biosynthesis of the animal or intestinal microorganisms. Some studies were executed with the aim of elaborating a method which enables a differentiation of different animal species (Verbeke and De Brabander, 1985; Saeed *et al.*, 1986; Schön, 1974; Matter, 1986; 1990; 1991; Larick *et al.*, 1989). Especially Saeed *et al.* (1986) and Matter (1990) recommended the fatty acid profiles as a mean to determine pork in "beef meat products". Eicosadienoic acid (C20:2) is of special importance in this case, as this fatty acid is believed to be in beef in concentrations less than 0.05% of the total fatty acids whereas pork meat should contain more than 0.7%. Publications of these authors let to a decision, that the examination of fatty acid profiles in beef products by an official GC procedure according to the German Food Regulations (§ 35 Lebensmittel- und Bedarfsgegenständegesetz) will decide wether a product is of pure beef or a mixture of beef and pork. As Matter describes (1990), beef and pork meat should show even further differences within the contents of C14:1-, C15:0-, and C 18:2-fatty acids. The concentration for pork with regard to C14:1 and C15:0 should be less than 0.05% and for C18:2 (linoleic acid) between 8 and 12%. C14:1 and C15:0 in beef meat should be higher than 0.05% and the C18:2 fatty acid smaller than 2.5%.

Our aim was to show, if these relationships hold true for different types of muscle meat and fat in beef animals.

MATERIALS AND METHODS

Material

The analyses were done with different muscles and fat of meat from fore and hind quarters of bull carcasses.

Methods

20g meat or fat is mixed with 10g Na_2SO_4, 15ml methanol:dichlormethane (1:2) and extracted at about 5000 rounds per minute using a Sorvall or Bühler homogeniser . This mixture is passed through a funnel containing a mixture of about 10g of Na_2SO_4 and seasand (1:1). The extract is concentrated to dryness. 20mg of the fat is dissolved in 1ml toluene. The fatty acids are transmethylated by addition of a reagent of 0.5ml trimethylsulphoniumhydroxide (Butte, 1983). 100μl of this mixture is diluted with 0.4ml toluene and analyzed (injection of 1μl, split ratio: 10:1) by gas chromatography using a DB 23 column with an internal diameter of 0.25mm and a stationary phase of 0.25μm, length 60m. The gas chromatographic conditions were as follows:

injector temperature: 260°C; detector temperature: 280°C; temperature program: two minutes at 100°C, heat rate: 4°C

per minute to 250°C, eight minutes at 250°C.

The evaluation of the gaschromatographic results has been done with a PC-program (Waters 810 Software).

Some of the data have been confirmed by GC/MS (Magnum Ion Trap, Finnigan MAT).

RESULTS AND DISCUSSION

The fat concentrations in beef in Germany are normally lower than the fat concentrations of pork. Normally the fat concentration in beef is about 10% or less, that's mainly the inter- and intramuscular fat with low fat deposits on the muscle surface. Investigating these fats we found the results, which are shown in Table 1.

The main concentration of eicosadienoic acid ($C_{20:2}$) in the meat was in the range of about 0.2-0.4% of the total fatty acid concentration especially in fore quarters which are used normally for sausage production. The $C_{14:1}$- and $C_{15:0}$-fatty acid concentrations were higher than 0.05% as Matter (1990) postulated. The same is true for the hind quarter where the highest concentrations of $C_{18:2}$ at 12.5% was measured. The $C_{20:2}$-concentrations of hind quarter meat was also higher than 0.05% (mainly between 0.2 and 0.26%). 0.05% is postulated by Matter (1990) as the highest concentration for beef meat.
These contradicting results may be explained as follows: The composition of fats in fatty tissue is quite different from the composition of inter- and intramuscular lipids. Lipids in fatty tissue of beef are mainly saturated triglycerides, whereas the fatty acid composition of inter- and intramuscular lipids are mainly unsaturated as they belong in their main part to phospholipids, which in general are highly unsaturated.

The question arises if the fatty acid composition of beef fat may be used for differentiation between pure beef products and mixtures of beef with pork. If the product is lean which means the fat content is lower than about 10%, one can assume, that fatty tissue is not added. The lipids in such products are mainly dominated by unsaturated fatty acids from the phospholipid fraction which means that these products contain a high percentage of linoleic (C 18:2) (far more than 2.5%) and eicosadienoic (C20:2) acid. The percentage of eicosadienoic acid in the phospholipid fraction is in general higher than 0.05%, mainly higher than 0.2%. Therefore beef meat products with low fat contents cannot be judged as mixtures of beef and pork by using eicosadienoic acid as a criterium when the total percentage of this fatty acid is higher than 0.05%. The higher the fat content of beef products is, that means meat mixed with fatty tissues, the higher is the possibility to find lower eicosadienoic fatty acid concentrations as 0.05%. But in some cases one has to be aware that a concentration of more than 0.05% eicosadienoic acid may be found in meat mixed with fatty tissues.

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Table 1. Content of different fatty acids in beef.

	C14:1	C15:0	C18:2	C20:2
fore quarter	0.07 - 0.2	0.3 - 0.4	4.0 - 10.8	0.05 - 0.72
hind quarter	0.8 - 5.3	0.3 - 0.4	11.0 - 12.5	0.0 - 0.26
depot fat	0.6 - 0.8	0.4 - 0.6	1.2 - 1.8	0.0 - 0.13