

## RELATIONSHIP BETWEEN CONTENTS OF CHOLESTEROL AND FAT IN MEAT CUTS

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**Background**

For many consumers and even worse so for a number of nutritionists meat of most species is regarded as high in fat content; the fat is believed to be composed mainly of saturated fatty acids and high in concentrations of cholesterol, strongly increasing with the fat content of the meat. It is ignored that in the last 50 years strong efforts have been undertaken to reduce the fat content of meat animals. In some breeds of pigs (e. g. Pietrain) or cattle (mainly in intact males of European breeds) the meat on the retail level is nowadays even too lean. The meat lacks flavour. The fatty acid composition of most meat species like pork, chicken or turkey consists of more than 50 % unsaturated fatty acids. Only beef fat has an about 50 : 50 ratio of saturated : unsaturated fatty acids. Cholesterol is essential for all animal tissues. It is a constituent of the lipid bilayer of the cell wall. Therefore the cholesterol content is related more to the cell surface area than to the fat content. Intensive studies have shown that the cholesterol content of most meat species and cuts is lower than reported in many data books.

**Objectives**

To measure the concentration of cholesterol and fat in various meat species and cuts and their relationships to human intake by eating meat. Studies about the situation in the Federal Republic of Germany are reported.

**Material**

Over about a decade in the various regions of Germany retail cuts of veal, beef, pork, chicken, turkey and lamb were collected. All cuts from animals were fed and slaughtered in the area of sale.

**Methods**

Proximate analyses were carried out according to the German reference methods laid down in § 35 of LMBG (food and food like or contacting material law). The cholesterol concentration was determined with method of Arneht u. Hussein (1995).

**Results and Discussion****1. Relation between fat and cholesterol**

The cholesterol and fat concentrations varies within a muscle. Figure 1 shows the results of 55 samples of *M. longissimus dorsi* (of beef). The fat content varied from 0.6 to 7.2 %; the cholesterol content ranged from 40 to 54 mg cholesterol/100 g of raw muscle. An even wider range of cholesterol content show single samples of other and fatter beef cuts. Variations from 46 to 67 mg cholesterol/100 g are observed. The mean values are 45.5 mg cholesterol/100 g in *M. long. dorsi* and 52.7 mg/100 g in the other cuts. There exists a small increase of cholesterol content with fat content. Between 1 % and 7.5 % fat in *M. long. dorsi* the mean cholesterol concentration increases from 44 to 49.5 mg/100 g; an increase of 12.5 % only vs 650 % increase in fat content. Comparing cholesterol contents of veal, beef, lamb and pork (Fig. 2) it becomes evident that beef and pork (mean values 50 to 65 mg/100 g) are very close to each other and also veal and lamb (60-75 mg/100g). The latter show about 10 mg cholesterol/100g higher concentrations over a fat variation of 1 to 30 %. In chicken and turkey cuts the increases are higher with increasing fat content (Fig. 2). In turkey breast 42 mg cholesterol/100 g have been measured, the highest value is with 80 mg/100 g nearly 100 % higher. In chicken cuts the breast has about 43 mg/100 g, chicken legs with skin or chicken wings go up to 90 resp. 95 mg cholesterol/100 g, again an increase to the double value. In both species the fat content starts with about 1 % in breast and ends of about 15 % in the fattest cut.

fig. 1 Relationship between cholesterol and fat content in beef cuts

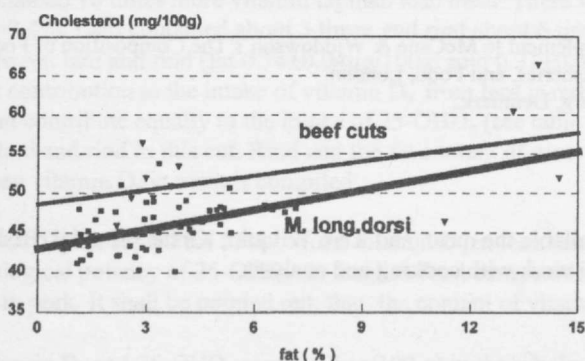
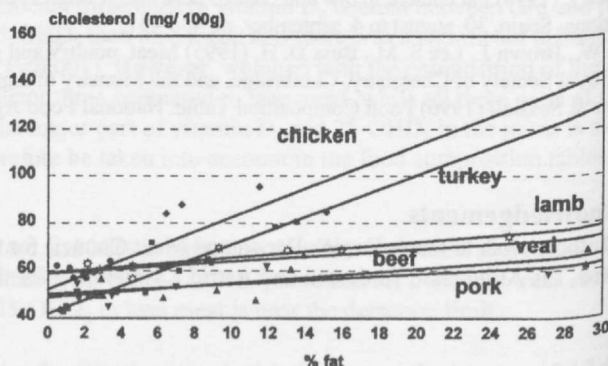


fig. 2 Relationship between cholesterol and fat content of meat from various species



In table 1 the correlations between constituents of lamb cuts are shown. The main constituents fat, protein and water have the usual close relationship of  $r > /0.80/$ . The relationship of cholesterol to fat, protein and water is very narrow between  $r = /0.62-0.65/$ . The equal correlation coefficients clearly show that cholesterol is not dependent only on fat content of meat. It is even more interesting to compare lean and fatty tissue like pork back fat (82 % fat) with pork belly (29 % fat) and leaner cuts. Above 15 % fat there is no increase in cholesterol content of tissues. The reason for the rather poor relationship of the lipophilic cholesterol and lipid content is due to the localisation of cholesterol in the membranes of tissues. Also fat cells need cholesterol in the membranes only. That is probably the reason why in pork no increase of cholesterol beyond 20 % fat is observed. The difference of beef and pork on one hand, veal and lamb or chicken and turkey on the other hand is most probably due to the size of the cells. The smaller the radius of a sphere the higher is the ratio of surface to volume (1  $\mu\text{m}$  radius: surface/volume = 3.0; 3  $\mu\text{m}$  radius: surface/volume = 0.75). With other words 100 g of meat with smaller cell diameters will have a higher surface area of cell walls than the ones with larger diameters.

## 2. Fat and cholesterol intake

After the analyses of cholesterol and fat in meat cuts of various species it has been evaluated how much fat and cholesterol the German consumer has available for consumption. As raw material the available amounts of meat and fat in carcasses on grading were taken. Those values have been used, as a considerable part of the meat and fat is processed into meat products (about 45 %). From these data the maximally available amount of fat for consumption has been calculated. 12.9 kg per head and year is maximally available. If one considers that 50 % of beef and lamb fat (= 0.75 kg/head · year) and about 20 % of pork fat (= 2.1 kg/head · year) are not consumed and go to fat rendering or to the waste bin, then 12.9-2.85 = about 10 kg fat/head · year are available for consumption. This amounts to 27.5 g/head · day. With the average cholesterol content for the species and the raw material available 34.94 g/head · year are available for intake. This amounts to 95.7 mg cholesterol/head and day. Non-healthy people should take up no more than 300 mg/day. 95.7 mg/day is less than 1/3 of this value.

## Conclusions

Meat is neither fat nor does it contain mainly saturated fatty acids. The cholesterol content ranges between 40 and 90 mg/100 g raw meat (offal has higher values) with average values between 53 and 68 mg cholesterol/100 g for the species. Calculating the fat and cholesterol available from meat for a German consumer the amount of 27.5 g fat and 95.7 mg cholesterol/day is lower than most textbooks and databanks report. There is no health hazard if average amounts of meat of about 170 g/head and day are consumed.

## References

Arneht W. and Hussein Al Hamad (1995), cholesterol - Its determination in muscle, adipose tissue and offals using HPLC. Fleischwirtschaft 75, 1001

Tab. 1 Linear correlation coefficients between constituents of lamb cuts (n = 64)

	cholesterol	fat	protein	connective tissue	water	ash
fat (1.55-33.7 %)	<b>+0.65</b>	-	-	-	-	-
protein (15.2-22.1 %)	<b>-0.62</b>	<b>-0.82</b>	-	-	-	-
connective tissue (0.3-1.9 %)	<b>+0.53</b>	<b>+0.60</b>	<b>-0.62</b>	-	-	-
water (50.2-76.8 %)	<b>-0.63</b>	<b>-0.99</b>	<b>+0.73</b>	<b>-0.56</b>	-	-
ash (0.75-1.3 %)	-0.29	<b>-0.72</b>	<b>+0.62</b>	<b>-0.51</b>	<b>+0.69</b>	-
vitamine E (0.11-0.45 mg/100 g)	+0.08	-0.03	+0.05	+0.06	+0.03	0.11

Tab. 2 Fat and cholesterol available for consumption in raw material in Germany

	raw material (kg/head · year)	fat content (%)	fat from carcass (kg/head · year)	fat available for consumption (kg/head · year)	cholesterol content (mg/100 g)	consumable cholesterol (g/head · year)
beef and veal	10.3	14.0	1.44	0.72	53	5.08
pork	40.3	26.1	10.52	8.42	55	21.01
poultry	8.9	8.5	0.76	0.76	68	6.05
lamb	0.8	7.4	0.06	0.03	65	0.50
other meats	1.0	4.0	0.04	0.04	65	0.65
offals	1.1	5.0	0.05	0.05	150	1.65
<b>sum</b>	<b>62.4</b>		<b>12.9</b>	<b>10.0</b>		<b>34.94</b>
in g / head · day	171		<b>35.3</b>	<b>27.5</b>		
in mg / head · day						<b>95.7</b>