Vitamin D_3 and 25-OH vitamin D_3 in raw and cooked pork loin

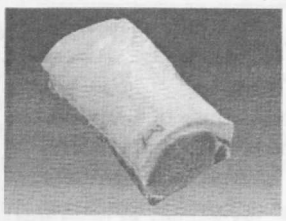
Ina Clausen, Jette Jakobsen, Lars Ovesen and Torben Leth
Danish Veterinary and Food Administration - Institute of Food Research and Nutrition

Background and Objectives

In Denmark, as in most European countries, vitamin D intake from food is below the recommended level (mean intake: 3.3 µg/day). An appropriate vitamin D status is important for optimal bone health and might be important for other health outcomes. People exposed to sunlight can synthesise the vitamin in the skin. Only a few natural foods contain large amounts of vitamin D, e.g., oily fish. Meat is another important source of vitamin D in the Danish diet, and from the Danish national dietary survey 32% of vitamin D intake comes from meat and meat products (not including poultry) (Andersen et al., 1995). The data on vitamin D content in meat in the Danish food composition tables have so far been based on few samples (Møller & Saxholt, 1996). It is not known which part of the meat (lean meat, fat or rind) is most rich in vitamin D_3. Another interesting point is how much 25-hydroxy vitamin D_3 (25-OHD_3), an intermediary metabolite formed in the liver, is present in meat. It has been argued that 25-OHD_3 has 5 times higher biological potency than vitamin D_3. The British food composition tables are compiled taking this assumption in account (Chan et al., 1995). Only insufficient data is available regarding the 25-OHD_3 content of fresh and prepared meat.

The purpose of the present study was to assess the vitamin D_3 and 25-OHD_3 contents in lean meat, lard and rind in pork loin, and to calculate losses of vitamin D_3 during cooking.

Materials and Methods



Eight pork loins boneless with rind (joints) were selected for analysis. The pigs were raised in stables from different farms without exposure to sunlight. The feed was enriched with about 25 µg vitamin D/kg feed. It is normal practice to add vitamin D to pigs feed in Denmark. The joints were divided into four equal parts, two analysed in the raw and two after cooking. The joints were cooked in an oven to an internal temperature of 80°C, and weighed before and after cooking. Prior to analysis the meat was separated into lean meat, lard (topfat), rind and a mixed part (containing both lard and meat). The latter accounted for approximately 20 % and was not analysed. All parts were weighed after separation and analysed for vitamin D_3, 25-OHD_3 and dry matter.

Vitamin D_3 was determined by high performance liquid chromatography (HPLC). After addition of vitamin D_2 as internal standard the unsaponifiable fraction was isolated by saponification with alcoholic potassium hydroxide and extraction with diethyl ether:petroleumether 50:50. After purification on a silica SPE the fractions of vitamin D_3 and 25-OHD_3 were separated using a combination of silica and amino columns with a gradient of isopropanol:n-heptan as mobile phase. The detection and quantitation were performed after separation on C18 columns for each of the 2 analytes. The mobile phases being acetonitrile-methanol and methanol:water, respectively. For both analytes detection was performed using a photo-diode array detector (220-320 nm), and quantitation at 265 nm. The vitamin D_3 content was calculated from the relation between the peak areas of vitamin D_2 and D_3, while 25-OHD_3 was calculated using external standard calibration. Dry matter was determined by drying 16-18 hours at 102-105°C (NMKL, No. 23).

Statistical analysis: Analysis of variance (ANOVA), SAS System for windows, version 6.12.

Results and discussions

Figure 1 shows the vitamin D_3 and 25-OHD_3 contents in raw pork loin separated into lean meat, lard and rind. Both lard and rind contained 10 times more vitamin D_3 than lean meat There was no significant difference in vitamin D_3 content between lard and rind (P=0.47). Lard contained about 3 times and rind about 6 times more 25-OHD_3 than lean meat, and there was a significant difference between lard and rind (fat 0.14±0.04µg/100g; rind 0.31±0.08µg/100g; P<0.001). However, weighed with the composition of the joint the contribution to the intake of vitamin D_3 from lard is reduced to a factor three compared to lean meat, while all three parts of the joint contribute equally to the intake of 25-OHD_3 (see table 1). Thus, the major part of vitamin D_3 and 25-OHD_3 in the joints is stored in lard and rind in this cut. Rind and the fat content of meat should therefore be taken into account in the food composition tables, when vitamin D_3 in meat is compiled.

25-OHD_3 accounted for 55% of total vitamin D_3 in lean meat, 25% in lard and 38% in rind. It is therefore important to ascertain the biological potency of 25-OHD_3. In English food composition tables (Chan et al.,1995) 25-OHD_3 accounts for 5-20% of total vitamin D_3 in pork. It shall be pointed out, that the content of vitamin D_3 and 25-OHD_3 in lean meat is near the detection limit.

Vitamin D_3 and 25-OHD_3 contents (µg/100 g) in the whole joints (except the mixed part) calculated from weight data were 0.17 ±0.06 and 0.10 ±0.04 respectively (mean ±SD). The fat content in the raw joints was estimated to be 18 g/100 g assuming that lean meat

contains 2 g fat /100 g, lard 75 g fat/100 g and rind 10 g fat/100 g, which is normal for this cut (Clausen, 1998). In Danish food composition tables (Møller & Saxholt,1996) the vitamin D content of all pork cuts, regardless of fat content, is given as 0.6 µg /100g.

Vitamin D_3 and 25-OHD_3 is not destroyed or lost with the meat juice during cooking from lean meat and lard. Raw and cooked lean meat and lard contained similar amounts of vitamin D_3 and 25-OHD_3/g dry matter (vitamin D_3: lean meat P=0.94, fat P=0.74 ; 25-OHD_3: lean meat P= 0.89, fat P=0.47). The fat lost during cooking will probably contain vitamin D_3 and 25-OHD_3. Weight loss during cooking was 37 ±2%. Concentration of the vitamin is therefore higher in cooked meat because of water loss. The concentration in cooked meat can be estimated when weight loss and fat loss are known.

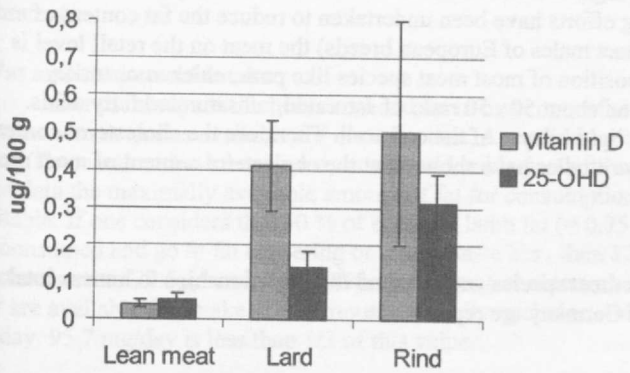


Figure 1. Contents of Vitamin D_3 and 25-OHD_3 in raw pork loin separated into lean meat, fat and rind (mean ± SD; n=8).

Table 1. Contribution (%) of vitamin D_3 and 25-OHD_3 from lean meat, lard and rind (n=8).

Loin with rind	weight %	Vitamin D_3 %	25-OHD_3 %
Lean meat	67	15	37
Lard	23	55	32
Rind	10	30	31

Conclusions

In pork loin vitamin D_3 and 25-OHD_3 are unevenly distributed in lean meat, lard and rind. Three to ten times more of the vitamin D_3 and 25-OHD_3 were found in lard and rind than in the lean meat. 25-OHD_3 accounted for 55% of total vitamin D_3 in lean meat, 25% in lard and 38% in rind. It is therefore important to ascertain the biological potency of 25-OHD_3. Vitamin D_3 and 25-OHD_3 were not destroyed or lost during cooking from the lean meat. The dripping fat will probably contain vitamin D_3, which will be lost unless it is eaten. More cuts are undergoing analysis to find out if different cuts contain similar amounts of vitamin D_3 and 25-OHD_3.

Literature

Andersen N.L., Fagt S., Groth M.V., Hartkopp H.B., Møller A., Ovesen L. and Warming D. L. (1995) Danish Dietary Survey, 1995. National Food Agency, Søborg, Denmark.

Clausen I. (1998) Fat content in raw and cooked pork cuts. Congress proceedings, 44rd International Congress of Meat Science and Technology, Barcelona, Spain, 30. august to 4. september, pp 436-437.

Chan W., Brown J., Lee S. M., Buss D. H. (1995) Meat, poultry and game – Supplement to McCane & Widdowson´s The Composition of Foods. The Royal Society of Chemistry, Cambridge, and the Ministry of Agriculture, Fisheries, and Food, London.

Møller & Saxholt (1996) Food Composition Table. National Food Agency, Søborg, Denmark.

Acknowledgements

The authors wish to thank Danish Bacon and Meat Council for making available the meat, and Kem Wilquin, Kirsten Pinndal, Heddi Worsøe, Lis Abildgaard Andersen and Astrid Kvindebjerg for the practical work with cooking and analysis.