NUTRITIONAL COMPOSITION OF DANISH BEEF

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Abstract – This study documented up-to-date nutrient data for Danish veal and beef products, reflecting present animal production and cut trimming techniques and was used as basis for the Danish fat tax and nutrition labeling. Average Holstein-Friesian carcasses, veal (n=8) and beef (n=8) were selected to generate complete sets of commercial cuts and products. Prior to nutrient analysis, samples for each product were pooled into one sample for veal and beef, respectively. Mean values for total fat and protein were obtained. A linear relationship between total and saturated fat was established on subsamples of veal and beef cuts as well as ground beef. Saturated fat was calculated from the total fat content of all analysed samples by multiplying by 0.410. For total fat, the majority of Danish red meat products contain less than 10 g fat per 100 g. Updated nutrient data on veal and beef products will enable consumers, health professionals and scientists to make appropriate dietary decisions. In addition the data serves as standard values for fat tax collection at cut level.

Key Words – beef, nutrition, saturated fat

I. INTRODUCTION

In 2011, the Danish government imposed the world's first tax on fatty foods [1] – the so-called "fat tax" – a radical move concerning fats from foods following on from Danish legislation introduced in 2003 aimed at banning the use of trans-fats. The fat tax imposes a surcharge on foods containing more than 2.3% saturated fat at a tax rate of approximately €2.15 per kg or $1.29 per pound of saturated fat in a product. Foods such as meat from cattle, chicken and pigs as well as cheese, butter and edible oils are affected by the tax. For beef, the surcharge should either be based on the actual saturated fat content of a given product (chemical analysis or nutrient composition data) or on the average saturated fat content of the carcass (standard rate is estimated to be 5.2% [2]).

The Danish Food Composition database [3] provides nutrient values for a list of certain retail beef cuts; however, data on total and saturated fat are based on 30-40 year-old data sources and is outdated with respect to present animal production, commercial cuts and more extensive trimming methods. A similar experience has been reported in the production of red meat in the US [4] and in the UK [5]. Moreover, Wyness *et al.* [6] reported a range of 2.4-10.4 g fat per 100 g raw lean beef in food composition data from selected countries due to infrequent updates of national nutrient data for beef.

Since the assessment of the fat tax is based on the Danish Food Composition data, it is necessary that the data are adequate, accurate and updated. Furthermore, the forthcoming EU nutrition labeling rules from 2014/2016 require a mandatory declaration of saturated fat as well as energy, fat, carbohydrates, sugars, protein and salt on packed food products [7].

This study provided updated nutrient data on total and saturated fat as well as protein for veal and beef cuts typically sold in today's Danish marketplace. Furthermore, a linear relationship between total and saturated fat was established.

II. MATERIALS AND METHODS

Carcass characteristics

Based on national slaughter statistics [8], representative average veal and beef carcasses were selected from the predominant Holstein-Friesian breed. Eight veal and eight beef carcasses were selected at a commercial beef processing plant over 2 weeks to match average classification characteristics as close as practically possible, thereby representing the average Danish cattle (Table 1).

Boning and cutting into products

Prior to cutting, the carcasses were chilled for 24 hours (3 carcasses for 72 hours). The carcasses were then cut into commercial veal and beef products according to standard Danish cutting specifications [9].

Table 1. Arithmetic mean values of the selected veal and beef carcass characteristics

		Weight	Age	Confor-mation[1]	Fat class	Colour
	n	*kg*	*month*			
Calf[2]						
Z	8	211.3	9	3.8	2.3	2.9
Beef[3]						
A	2	266.5	12	4.6	2.6	2.9
E	2	247.8	30.5	1.8	2.3	3
D	4	293.4	63.3	2.1	2.5	3.1

[1]EUROP. [2]Age >8 to ≤ 12 months. [3]A: Young bull, E: Heifer, D: Cow

By-products were collected from similar carcasses meeting the classification criteria given in Table 1. Each cut/product was weighed, vacuum-packed and stored at 2˚C until further analysis during the following two weeks. Fresh ground beef samples with 5 different commercial fat content ranges were collected in 500 g trays from a commercial meat processing plant. Subsamples for each fat range were randomly selected from four different batches per day on four different days.

Sample preparation (pooling of samples)

Within each category, the eight samples for each cut/product were pooled into one sample. The pooled sample was created by grinding the muscles together through a 2 mm plate (Bizerba) for 2-3 rounds. Samples >5 kg were ground for 10 and 20 rotations at, respectively, low and high speed (NIROCUT NC-45) prior to grinding with 2 mm plate. Quality control of the pooling process was documented for thin flank (lean) and eye of round (fat) by analysing each of the eight samples separately as well as the pooled sample. After homogenisation, samples weighing 50 g were selected and stored at -18°C until analysis.

Chemical analysis

Duplicate samples of homogenised products for veal and beef were analysed for total fat content by the gravimetric method using SBR (Schmid-Bodzinski-Ratzlaff), based on NMKL No. 131, 1989. Protein content was also analysed by a Kjeldahl analysis based on AOAC Official Method 981.10, 1983. Saturated fat levels were determined by a GC-FID analysis in selected veal and beef products (n=20) and in samples of ground beef (n=5), all with varying fat content.

The original report can be found on DMRI's website [10].

III. RESULTS AND DISCUSSION

Relationship between total and saturated fat

From the subsamples a clear linear relationship between total and saturated fat was established (r^2 = 0.997) for both lean and fatty products and for ground beef, see figure 1. Based on this result, the saturated fat content in veal and beef products can be easily calculated from the total fat content by multiplying the total fat value by 0.410.

This calculation can also be applied to ground beef based on the average total fat content. For cost efficiency reasons, and in the view that accuracy and agreement on standard methods of saturated fat analysis is much lower than for total fat analysis, it was decided to estimate all saturated fat values by these factors.

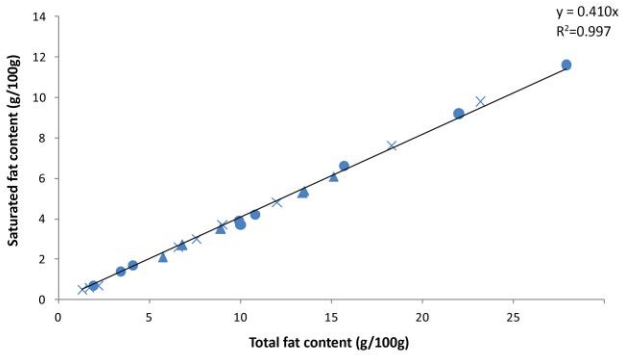

Figure 1. Linear relationship between total and saturated fat content in veal cuts (x), beef cuts (●) and ground beef (Δ).

Nutritional composition of veal and beef

The total fat, saturated fat and protein contents for all veal and beef products are shown in Table 2. As expected, fat levels differ between veal and beef as veal products have a lower fat content. The fat levels are generally low: 77% and 52% of Danish veal and beef muscle cuts, respectively, contain less than 10 g fat per 100 g. The majority of Danish red meat products therefore meet the Danish Veterinary and Food Administration guidelines *"to limit fat intake especially from milk and meat products by choosing meat with maximum 10% fat".* Concerns about fat from meat

Table 2. Total fat, saturated fat and protein content in Danish veal and beef (g/100 g).

	VEAL			BEEF				VEAL			BEEF		
Item	Total fat	Sat. fat	Pro-tein	Total fat	Sat. fat	Pro-tein	Item	Total fat	Sat. fat	Pro-tein	Total fat	Sat. fat	Pro-tein
Hindquarters	9.0	3.7	20.3	12.4	5.1	21.2	Culotte	9.0	3.7	19.7	10.8	4.4	19.1
Full loin	9.1	3.7	18.9	12.4	5.1	20.0	Silverside	4.4	1.8	21.8	5.9	2.4	21.0
Leg	8.5	3.5	20.3	12.0	4.9	21.2	Silverside wo/fat	3.0	1.2	21.8	4.0	1.6	21.1
Round w/ shank	8.4	3.4	20.3	11.7	4.8	21.2	Silverside PAD	1.6	0.7	21.8	2.8	1.1	21.0
Long loin	10.7	4.4	20.1	14.3	5.9	21.2	Muscle	2.7	1.1	22	4.2	1.7	21.8
Full rib w/bones	11.0	4.5	20.1	15.5	6.4	21.2	Forequarters w/flank	11.4	4.7	19.4	16.1	6.6	20.2
Full rib, boneless	10.2	4.2	20.5	13.6	5.6	19.8	Forequarters wo/flank	10.0	4.1	19.6	14.7	6.0	20.5
Short loin w/bones	11.5	4.7	20.1	13.5	5.5	22.7	Shoulder w/shin	8.7	3.6	20	12.6	5.2	21.3
Short loin, boneless	9.1	3.7	20.4	10.2	4.2	20.5	Shoulder wo/shin	9.1	3.7	19.7	13.0	5.3	20.6
T-bone	9.8	4.0	20.3	11.7	4.8	22.1	Shoulder clod	6.3	2.6	20.6	8.3	3.4	20.4
Full rib w/bones, 5 bones	10.8	4.4	20.3	15.4	6.3	21.8	Shoulder clod (trimmed)	6.4	2.6	20.6	8.6	3.5	20.3
Full rib wo/bones, 5 bones	9.3	3.8	20.9	13.4	5.5	20.1	Shoulder clod (extra trimmed)	2.5	1.0	21.3	3.9	1.6	21.5
Entrecote w/bones	11.2	4.6	19.7	15.7	6.4	20.4	Feather blade	6.0	2.5	20.6	8.1	3.3	20.4
Entrecote w/cap	11.3	4.6	19.6	15.4	6.3	18.4	Feather blade PAD	3.0	1.2	20.4	4.4	1.8	20.5
Entrecote wo/cap	7.7	3.2	20.6	10.8	4.4	19.7	Blade roll	2.7	1.1	19.8	3.7	1.5	20.0
Striploin	9.3	3.8	20.9	12.3	5.0	20.5	Shin w/bones	7.3	3.0	21	10.9	4.5	23.9
Full rib, boneless wo/fat	1.9	0.8	21.9	3.7	1.5	21.4	Shin meat	4.7	1.9	21.9	6.3	2.6	22.0
Full rib, boneless wo/fat & short loin	1.9	0.8	22.1	3.6	1.5	21.5	Backrib w/bones & neck	7.7	3.2	20	11.3	4.6	21.1
Full rib, boneless wo/fat & cervical ligament	4.3	1.8	21.3	6.7	2.7	20.7	Backrib, long	6.1	2.5	19.4	9.0	3.7	19.1
Tenderloin w/fat & strap muscle	7.5	3.1	20.2	9.5	3.9	19.3	Backrib, short	6.6	2.7	19.2	9.9	4.1	18.9
Tenderloin wo/fat w/strap muscle	3.6	1.5	21	6.0	2.5	19.9	Briskets w/bones	15.6	6.4	18.6	21.1	8.7	19.0
Tenderloin wo/fat & strap muscle	2.7	1.1	20.8	4.8	2.0	19.9	Briskets	15.1	6.2	18.5	20.1	8.2	17.4
Chateaubriand	2.5	1.0	21.1	5.0	2.1	19.9	Thin flank	8.1	3.3	19.6	10.7	4.4	19.0
Topside	4.5	1.8	21.2	5.3	2.2	21.0	Thin flank 22 x 40	7.6	3.1	19.7	10.0	4.1	19.4
Topside wo/cap	2.1	0.9	21.9	2.9	1.2	21.6	Thin flank, middle	17.1	7.0	18.3	21.5	8.8	17.4
Topside PAD	1.3	0.5	22	2.3	0.9	21.7	Flank w/bones	15.3	6.3	19	19.8	8.1	19.5
Full rump w/cap	5.9	2.4	20.7	7.1	2.9	20.3	Flank steak	4.5	1.8	20.9	6.7	2.7	20.0
Rump wo/fat w/cap	3.7	1.5	21.1	5.4	2.2	20.5	Flank steak PAD	2.7	1.1	21.1	5.0	2.1	20.2
Rump w/fat wo/cap	5.1	2.1	21	5.8	2.4	20.5	Bavette	6.1	2.5	19.8	8.4	3.4	19.2
Rump	2.4	1.0	21.5	3.5	1.4	20.9	Bavette PAD	2.9	1.2	20.2	6.1	2.5	19.4
Rump PAD	1.9	0.8	21.5	2.9	1.2	21.0	Tail	12.2	5.0	19.8	17.0	7.0	22.8
Eye of round	4.0	1.6	21.3	5.1	2.1	20.9	Heart	8.6	3.5	16.9	8.6	3.5	17.1
Eye of round PAD	1.3	0.5	21.6	1.9	0.8	21.3	Liver	2.9	1.2	19.1	3.3	1.4	19.2
Osso Buco	9.4	3.9	20.2	14.3	5.9	20.9	Tongue	13.1	5.4	17.0	16.8	6.9	16.5
Knuckle	4.1	1.7	20.1	5.1	2.1	20.2	Kidney	3.2	1.3	15.7	-	-	-
Knuckle (German cut)	2.8	1.1	20.6	3.6	1.5	20.7	Diaphragm w/membrane	17.5	7.2	19.1	12.1	5.0	19.2
Knuckle PAD	1.6	0.7	20.7	2.3	0.9	20.8	Thymus gland	6.4	2.6	17.3	-	-	-
Cuvette	8.7	3.6	20.4	11.1	4.6	19.6	Thick Skirt	6.2	2.5	19.3	7.8	3.2	19.0
Cuvette, triangle shaped	8.0	3.3	20.6	10.5	4.3	19.8	Head meat	8.8	3.6	21.0	10.3	4.2	21.2

w: with - wo: without - PAD: Peeled And Denuded
A full product catalogue with product pictures is given [9]

arise from the epidemiological association between red meat intake and cardiovascular health. However, recent evidence shows that red meat as part of a diet low in saturated fat (≤10%) does not increase cardiovascular risk factors [11] and that saturated fat is not associated with risk of heart disease [12]. The low levels of fat in the veal and beef cuts are a result of changes in animal production and trimming practices and are not unique to the Danish beef production industry. Other papers have addressed the progressive reduction in the fat content of red meat [4,5] and have described how red meat can now be regarded as a low fat food compared with 20 years ago.

The present results document current levels of fat in Danish veal and beef products, and these data were readily adopted by the Danish beef industry when the fat tax was implemented in October 2011. The protein content did not vary considerably between veal and beef products or among the different meat products, apart from lower values for heart, kidney and thymus.

From 16 December 2016, EU regulations require mandatory declaration of energy, fat, saturated fat, protein, carbohydrates, sugars and salt. The present study provides data on fat, saturated fat and protein in Danish veal and beef cuts and can be used as documentation for nutrition labeling. As the carbohydrate content in meat is nearly non-existent or ≤1 g/100 g [3,13], the energy content can be easily calculated using the approximate energy conversion factors for food components in conjunction with the present results for a given veal or beef product:

Energy (kJ) = protein (g/100g) x 17 kJ/g + carbohydrate (g/100g) x 17 kJ/g + fat (g/100g) x 37 kJ/g [7].

Salt (NaCl) content varies little in beef and veal cuts [3,13] and is relatively low in fresh meat products. From the present study selected cuts had an average salt content of 0.17 g/100 g [unpublished data]. Taken together, the present study provides the full basic documentation for nutrition labeling in Danish veal and beef products.

IV. CONCLUSION

Nutritional data on total fat, saturated fat and protein was documented for veal and beef products in the Danish marketplace. The low levels of fat reflect the changes in animal production and product trimming that have occurred over the last 20-30 years. The present study found a clear linear relationship between the total and saturated fat content in veal and beef cuts and also in ground beef. The saturated fat content in Danish veal and beef meat was estimated to 41.0% of total fat.

These new and updated data will benefit the beef industry, consumers and health professionals. They are also used as a basis for the Danish fat tax collection at cut level.

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