



Report on nutrient analysis of key cuts of pork

Analytical Report

2020

QIB Extra Ltd / Food Databanks National Capability
Quadram Institute
Norwich Research Park
Norwich, NR4 7UQ, UK

February 2020

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This work was carried out at the Quadram Institute Bioscience, Norwich under contract to Agriculture and Horticulture Development Board and with co-funding from Public Health England. The author(s) gratefully acknowledge the support of the Biotechnology and Biological Sciences Research Council (BBSRC); this research was also funded by the BBSRC Core Capability Grant BB/CCG1860/1 and its constituent project BBS/E/F/00044600 Food Databanks National Capability.

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Executive Summary

Agriculture and Horticulture Development Board (AHDB) and Public Health England (PHE) commissioned Quadram Institute Bioscience (QIB) Extra to carry out nutrient analysis of a range of pork cuts. The aim of this survey was to provide up-to-date nutrient composition data for commonly consumed cuts and leaner cuts of pork that are becoming more popular. Changes in breeding and feeding practices along with modern butchery methods mean that a wide range of lean cuts are now routinely available to the consumer. The last comprehensive nutrient analysis survey of pork in the UK was completed in 1992/3. Since the early 90s, in response to the public health need to reduce fat intake, the livestock industry has made comprehensive changes to production and processing methods. It is thought these changes have resulted in significant reductions in the fat content of red meat.

The nutrient composition data generated by this survey will be used to update and extend the data currently held by PHE and will be incorporated into the nutrient databank that supports the UK National Diet and Nutrition Survey and also disseminated via the authoritative UK food composition tables, *McCance and Widdowson's The Composition of Foods*. The data will be incorporated into the next update of the online Composition of Foods Dataset ([CoFID](#)) (early 2020) which will be disseminated via the new Composition of Foods searchable website (www.quadram.ac.uk/UKfoodcomposition/).

This project analysed 10 composite samples that were each made up of between 10 and 11 sub-samples. Samples were purchased from retail outlets and prepared for analysis between January and February 2019.

These composite samples were analysed for proximates, minerals and vitamins between February and March 2019. Results for individual fatty acids in selected samples are reported separately in electronic format. Details of the sub-samples making up each composite sample can be found in a separate report.

A further complementary report, containing calculated values for whole cuts (lean and fat) and trimmed cuts (lean and some fat) is also available.



Methods

This survey updates information on nutrients which were last analysed in 1992/3. Priorities were based on cuts which were commonly consumed and which were deemed to be becoming more popular. The sampling list was finalised following consultation with AHDB and PHE.

Sampling list

The list of food samples (sub-samples) was based on consumer and retail data so that samples reflected current market and purchasing trends. Samples were designed to incorporate data on market share for high-street and supermarket shops, pork origin (ratio of UK to EU pork), 'quality' of products (premium, standard and economy), and to include sub-samples from food service suppliers (reflecting foods consumed outside of the home).

Frozen and organic products were excluded as most products are found fresh and organic produce has a very low market share in the UK pork market. Outdoor reared pork was included where appropriate. Products containing added ingredients (e.g. sugar, salt, fat, water) were omitted. The availability of pork cuts in shops (based on market share) influenced the sampling list in addition to the above sampling parameters.

Purchasing

Sub-samples were purchased from retail outlets in the Norwich area and prepared for analysis between January and February 2019. All fresh pork samples were stored at 4°C after purchase and prepared as soon as possible, within the recommended use by date. Shopping took place in person from shops rather than online to ensure the correct samples were included. The retail outlets included supermarkets, independent butchers and catering suppliers. Where possible, joints of different sizes were purchased for sampling. Visible fat content, e.g. marbling, can vary between the same type of product therefore where sub-samples were to be used for both uncooked and cooked analysis, shoppers made sure to select sub-samples with a similar visible fat appearance to reduce variation relating to the sample choice.

Preparation

Cooked samples were prepared using normal domestic practices and in accordance with packaging instructions, and where necessary, using instructions provided by AHDB. Sub-samples were cooked with the fat on and then the fat was removed and weighed before analysis. Pork legs were cooked medium, at 180-190°C for 30 minutes per 450g plus an additional 30 minutes until an internal temperature of 75-80°C was reached, and the rind/crackling was scraped of fat and excluded from analysis. Pork loin steaks were grilled on a moderate heat for 8 minutes each side, or until done.



Dissection of lean and fat

The dissection of the lean and fat portions affects the analytical value for fat and protein content therefore a standard protocol was agreed. Fat was “extra trimmed” (all visible fat removed) from the lean whilst still being in line with consumer practices, e.g. using a standard kitchen knife. It should be noted that it is more difficult to determine fat vs lean in cooked meat portions. Any layer of visible fat in the fillet and loin medallions was also removed and weighed during sampling (the lean portion only was analysed and reported, however, analytical values for the fat portion of pork loin steaks will be used to ‘reconstruct’ the cuts as purchased for inclusion in the CoFID).

Weighing the fat and lean parts within each cut allowed the calculation of a complete fat to lean percentage. These weights were recorded at different stages, i.e. subcutaneous fat was removed and weighed first and then the intermuscular fat was removed and weighed (Figure 1). Intramuscular fat (fat marbling) was not removed from the lean portion, therefore total fat analysed was subcutaneous and intermuscular fat only. Inedible parts, e.g. bones, were recorded and weighed.

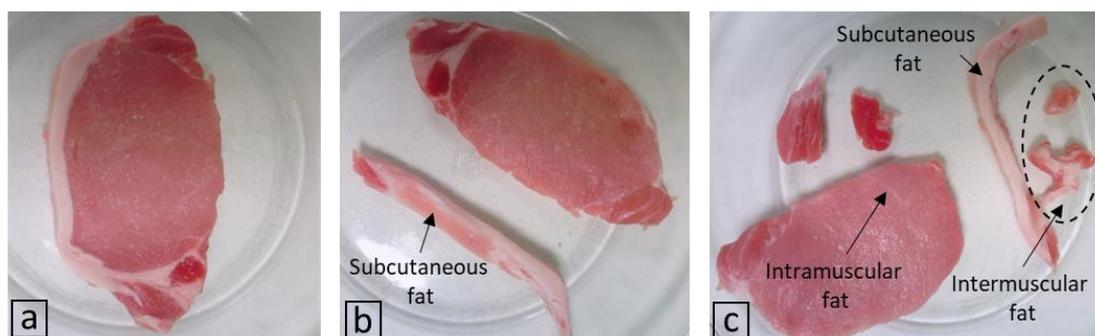


Figure 1. Classification of fat and lean portions (a. pork loin steak as purchased; b. separation of subcutaneous fat; c. separation of subcutaneous and intermuscular fat)

Sub-samples were combined into 10 composite samples for analysis. Each composite was made up of between 10 and 11 homogenised sub-samples, combined on an equal weight basis. Composites were analysed for proximates, individual fatty acids, vitamins and minerals between February and March 2019 and stored at -40°C prior to analysis.

A full list of the composite food samples analysed is given on page 7.

Composite Sample List

Sample Number	Sample Name	Description
1	Pork fillet medallions, uncooked, lean portion	10 samples, 6 products, chilled
2	Pork loin medallions, uncooked, lean portion	10 samples, 8 products, chilled
3a	Pork loin steak, uncooked, lean portion	11 samples, 11 products, chilled
3b	Pork loin steak, uncooked, fat portion	11 samples, 11 products, chilled
4a	Pork loin steak, grilled, lean portion	11 samples, 11 products, chilled
4b	Pork loin steak, grilled, fat portion	11 samples, 11 products, chilled
5a	Pork leg roasting joint, uncooked, lean portion	11 samples, 11 products, chilled
5b	Pork leg roasting joint, uncooked, fat portion	11 samples, 11 products, chilled
6a	Pork leg roasting joint, roasted, lean portion	11 samples, 11 products, chilled
6b	Pork leg roasting joint, roasted, fat portion	11 samples, 11 products, chilled



Analysis and Results

Notes Relating to Analysis

- Protein is calculated from total nitrogen using the nitrogen conversion factors shown.
- The values given for fat refer to total fat and not just triglycerides.
- Metabolisable energy is given in kilocalories (kcal) and kilojoules (kJ). These values have been calculated from protein, fat and carbohydrate using the following energy conversion factors:

	kcal/g	kJ/g
• Protein	4	17
• Fat	9	37
• Available carbohydrate	3.75	16

- Saturated, cis-monounsaturated, cis-polyunsaturated, and trans fatty acids have been calculated from summations of individual fatty acids and are shown as g/100g food. A conversion factor has been used to allow for the non-triglyceride fraction of the lipid and calculate fatty acids g/100g food from g/100g fatty acid methyl esters. The conversion factors used depend on the main fat source of the food and are taken from the tables given in the 7th Summary edition of McCance and Widdowson's *The Composition of Foods*.
- Results for individual fatty acids, for selected samples, are available separately in electronic format.
- Total vitamin D in meat is calculated as the sum of vitamin D₃ (cholecalciferol) and five times¹ 25-hydroxy vitamin D₃

¹ Finglas et al. (2015) McCance and Widdowson's *The Composition of Foods*, Seventh summary edition. Cambridge: Royal Society of Chemistry; Cashman et al. (2012) Relative effectiveness of oral 25-hydroxyvitamin D₃ and vitamin D₃ in raising wintertime serum 25-hydroxyvitamin D in older adults. *Am J Clin Nutr* 95, 1350-6



- Total vitamin E is expressed as α -tocopherol equivalents and is calculated using the following conversion factors for vitamin E activity:

▪ α -tocopherol	x	1.00
▪ β -tocopherol	x	0.40
▪ δ -tocopherol	x	0.01
▪ γ -tocopherol	x	0.10
▪ α -tocotrienol	x	0.30
▪ β -tocotrienol	x	0.05
▪ γ -tocotrienol	x	0.01

- Some values are reported as '<' meaning that the result was below the analytical limit of quantification (LOQ) or limit of detection (LOD). There is no distinction between '<' and 'not detected'.
- Where no value is given, the nutrient was not analysed in that sample. It should not be assumed that the sample does not contain that nutrient.
- Proximate, inorganic and vitamin analysis and analysis of individual fatty acids was performed by Eurofins laboratories and Campden BRI Ltd between February and March 2019. Vitamin D analysis was performed by Technical University of Denmark (DTU).

Evaluation of Data

Values provided by analytical laboratories were compiled in Excel spreadsheets for data evaluation. Where possible, analytical values were compared to other sources of comparable data. Sources used included UK Food Composition tables, other food composition tables and information from manufacturers and retailers. Where analytical values appeared incorrect or questionable, data was checked against original laboratory reports and re-analysed if necessary.

Results for all composite samples are given below



Sample 1: Pork fillet medallions, uncooked, lean portion

PROXIMATES

Water	74.6	g/100g
Total Nitrogen	3.65	g/100g
Nitrogen conversion factor	6.25	
Protein	22.8	g/100g
Fat	0.5	g/100g
Ash	1.2	g/100g
Energy (kcal)	96	kcal/100g
Energy (kJ)	406	kJ/100g
Cholesterol	64	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	0.16	g/100g
cis-monounsaturated	0.15	g/100g
cis n-3 polyunsaturated	0.01	g/100g
cis n-6 polyunsaturated	0.11	g/100g
cis polyunsaturated	0.11	g/100g
Trans	<0.01	g/100g

INORGANICS

Sodium (Na)	42	mg/100g
Potassium (K)	420	mg/100g
Calcium (Ca)	6	mg/100g
Magnesium (Mg)	28	mg/100g
Phosphorus (P)	225	mg/100g
Iron (Fe)	0.99	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	1.7	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	18	µg/100g
Sulphur (S)	223	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.86	mg/100g
Riboflavin	0.28	mg/100g
Niacin	8.9	mg/100g
Tryptophan/60	4.8	mg/100g
Vitamin B ₆	0.32	mg/100g
Folate	4	µg/100g
Pantothenic acid	1.20	mg/100g
Biotin	4.8	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.5	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	0.29	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	0.29	mg/100g
Vitamin D ₃		µg/100g
25-hydroxy vitamin D ₃		µg/100g
Total vitamin D		µg/100g



Sample 2: Pork loin medallions, uncooked, lean portion

PROXIMATES

Water	73.7	g/100g
Total Nitrogen	3.79	g/100g
Nitrogen conversion factor	6.25	
Protein	24.8	g/100g
Fat	1.9	g/100g
Ash	1.2	g/100g
Energy (kcal)	116	kcal/100g
Energy (kJ)	492	kJ/100g
Cholesterol	58	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	0.65	g/100g
cis-monounsaturated	0.77	g/100g
cis n-3 polyunsaturated	0.02	g/100g
cis n-6 polyunsaturated	0.27	g/100g
cis polyunsaturated	0.29	g/100g
Trans	<0.01	g/100g

INORGANICS

Sodium (Na)	41	mg/100g
Potassium (K)	405	mg/100g
Calcium (Ca)	5	mg/100g
Magnesium (Mg)	27	mg/100g
Phosphorus (P)	215	mg/100g
Iron (Fe)	0.43	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	1.3	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	17	µg/100g
Sulphur (S)	209	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.70	mg/100g
Riboflavin	0.12	mg/100g
Niacin	10.1	mg/100g
Tryptophan/60	5.3	mg/100g
Vitamin B ₆	0.29	mg/100g
Folate	4	µg/100g
Pantothenic acid	0.73	mg/100g
Biotin	3.8	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.3	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	0.28	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	0.28	mg/100g
Vitamin D ₃		µg/100g
25-hydroxy vitamin D ₃		µg/100g
Total vitamin D		µg/100g



Sample 3a: Pork loin steak, uncooked, lean portion

PROXIMATES

Water	73.2	g/100g
Total Nitrogen	3.71	g/100g
Nitrogen conversion factor	6.25	
Protein	23.2	g/100g
Fat	1.9	g/100g
Ash	1.1	g/100g
Energy (kcal)	110	kcal/100g
Energy (kJ)	465	kJ/100g
Cholesterol	63	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	0.66	g/100g
cis-monounsaturated	0.79	g/100g
cis n-3 polyunsaturated	0.02	g/100g
cis n-6 polyunsaturated	0.25	g/100g
cis polyunsaturated	0.27	g/100g
Trans	<0.01	g/100g

INORGANICS

Sodium (Na)	49	mg/100g
Potassium (K)	401	mg/100g
Calcium (Ca)	5	mg/100g
Magnesium (Mg)	26	mg/100g
Phosphorus (P)	208	mg/100g
Iron (Fe)	0.44	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	1.5	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	21	µg/100g
Sulphur (S)	212	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.64	mg/100g
Riboflavin	0.12	mg/100g
Niacin	9.1	mg/100g
Tryptophan/60	5.1	mg/100g
Vitamin B ₆	0.31	mg/100g
Folate	4	µg/100g
Pantothenic acid	0.80	mg/100g
Biotin	3.8	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.3	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	0.26	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	0.26	mg/100g
Vitamin D ₃		µg/100g
25-hydroxy vitamin D ₃		µg/100g
Total vitamin D		µg/100g



Sample 3b: Pork loin steak, uncooked, fat portion

PROXIMATES

Water	34.1	g/100g
Total Nitrogen	1.94	g/100g
Nitrogen conversion factor	6.25	
Protein	11.5	g/100g
Fat	59.8	g/100g
Ash	0.5	g/100g
Energy (kcal)	584	kcal/100g
Energy (kJ)	2408	kJ/100g
Cholesterol	64	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	22.55	g/100g
cis-monounsaturated	25.17	g/100g
cis n-3 polyunsaturated	0.67	g/100g
cis n-6 polyunsaturated	8.00	g/100g
cis polyunsaturated	8.78	g/100g
Trans	0.10	g/100g

INORGANICS

Sodium (Na)	23	mg/100g
Potassium (K)	157	mg/100g
Calcium (Ca)	3	mg/100g
Magnesium (Mg)	9	mg/100g
Phosphorus (P)	84	mg/100g
Iron (Fe)	0.25	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	0.5	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	<0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	8	µg/100g
Sulphur (S)	60	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.22	mg/100g
Riboflavin	0.05	mg/100g
Niacin	4.2	mg/100g
Tryptophan/60	1.1	mg/100g
Vitamin B ₆	0.15	mg/100g
Folate	4	µg/100g
Pantothenic acid	0.42	mg/100g
Biotin	3.1	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.6	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	0.34	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	0.34	mg/100g
Vitamin D ₃		µg/100g
25-hydroxy vitamin D ₃		µg/100g
Total vitamin D		µg/100g



Sample 4a: Pork loin steak, grilled, lean portion

PROXIMATES

Water	57.7	g/100g
Total Nitrogen	5.62	g/100g
Nitrogen conversion factor	6.25	
Protein	35.1	g/100g
Fat	5.9	g/100g
Ash	2.1	g/100g
Energy (kcal)	194	kcal/100g
Energy (kJ)	815	kJ/100g
Cholesterol	89	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	2.15	g/100g
cis-monounsaturated	2.41	g/100g
cis n-3 polyunsaturated	0.06	g/100g
cis n-6 polyunsaturated	0.74	g/100g
cis polyunsaturated	0.80	g/100g
Trans	0.01	g/100g

INORGANICS

Sodium (Na)	57	mg/100g
Potassium (K)	453	mg/100g
Calcium (Ca)	6	mg/100g
Magnesium (Mg)	33	mg/100g
Phosphorus (P)	262	mg/100g
Iron (Fe)	0.62	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	2.1	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	29	µg/100g
Sulphur (S)	287	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.78	mg/100g
Riboflavin	0.18	mg/100g
Niacin	8.7	mg/100g
Tryptophan/60	7.7	mg/100g
Vitamin B ₆	0.19	mg/100g
Folate	4	µg/100g
Pantothenic acid	1.08	mg/100g
Biotin	7.2	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.5	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	0.16	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	0.16	mg/100g
Vitamin D ₃	0.27	µg/100g
25-hydroxy vitamin D ₃	0.18	µg/100g
Total vitamin D	1.2	µg/100g



Sample 4b: Pork loin steak, grilled, fat portion

PROXIMATES

Water	26.9	g/100g
Total Nitrogen	2.91	g/100g
Nitrogen conversion factor	6.25	
Protein	18.2	g/100g
Fat	56.9	g/100g
Ash		g/100g
Energy (kcal)	585	kcal/100g
Energy (kJ)	2415	kJ/100g
Cholesterol		mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated		g/100g
cis-monounsaturated		g/100g
cis n-3 polyunsaturated		g/100g
cis n-6 polyunsaturated		g/100g
cis polyunsaturated		g/100g
Trans		g/100g

INORGANICS

Sodium (Na)		mg/100g
Potassium (K)		mg/100g
Calcium (Ca)		mg/100g
Magnesium (Mg)		mg/100g
Phosphorus (P)		mg/100g
Iron (Fe)		mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)		mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)		mg/100g
Iodine (I)		µg/100g
Selenium (Se)		µg/100g
Sulphur (S)		mg/100g

WATER SOLUBLE VITAMINS

Thiamin		mg/100g
Riboflavin		mg/100g
Niacin		mg/100g
Tryptophan/60		mg/100g
Vitamin B ₆		mg/100g
Folate		µg/100g
Pantothenic acid		mg/100g
Biotin		µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂		µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol		mg/100g
Beta-tocopherol		mg/100g
Delta-tocopherol		mg/100g
Gamma-tocopherol		mg/100g
Vitamin E		mg/100g
Vitamin D ₃	1.20	µg/100g
25-hydroxy vitamin D ₃	0.26	µg/100g
Total vitamin D	2.5	µg/100g



Sample 5a: Pork leg roasting joint, uncooked, lean portion

PROXIMATES

Water	74.0	g/100g
Total Nitrogen	3.70	g/100g
Nitrogen conversion factor	6.25	
Protein	23.1	g/100g
Fat	3.3	g/100g
Ash	1.1	g/100g
Energy (kcal)	122	kcal/100g
Energy (kJ)	515	kJ/100g
Cholesterol	67	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	1.10	g/100g
cis-monounsaturated	1.45	g/100g
cis n-3 polyunsaturated	0.03	g/100g
cis n-6 polyunsaturated	0.37	g/100g
cis polyunsaturated	0.41	g/100g
Trans	<0.01	g/100g

INORGANICS

Sodium (Na)	56	mg/100g
Potassium (K)	377	mg/100g
Calcium (Ca)	5	mg/100g
Magnesium (Mg)	26	mg/100g
Phosphorus (P)	205	mg/100g
Iron (Fe)	0.64	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	1.8	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	22	µg/100g
Sulphur (S)	208	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.46	mg/100g
Riboflavin	0.09	mg/100g
Niacin	10.6	mg/100g
Tryptophan/60	4.9	mg/100g
Vitamin B ₆	0.34	mg/100g
Folate	5	µg/100g
Pantothenic acid	0.86	mg/100g
Biotin	4.3	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.5	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	0.30	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	0.30	mg/100g
Vitamin D ₃		µg/100g
25-hydroxy vitamin D ₃		µg/100g
Total vitamin D		µg/100g



Sample 5b: Pork leg roasting joint, uncooked, fat portion

PROXIMATES

Water	33.7	g/100g
Total Nitrogen	1.07	g/100g
Nitrogen conversion factor	6.25	
Protein	6.7	g/100g
Fat	63.8	g/100g
Ash	0.4	g/100g
Energy (kcal)	601	kcal/100g
Energy (kJ)	2475	kJ/100g
Cholesterol	87	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	22.86	g/100g
cis-monounsaturated	29.36	g/100g
cis n-3 polyunsaturated	0.71	g/100g
cis n-6 polyunsaturated	7.23	g/100g
cis polyunsaturated	8.09	g/100g
Trans	0.13	g/100g

INORGANICS

Sodium (Na)	30	mg/100g
Potassium (K)	135	mg/100g
Calcium (Ca)	2	mg/100g
Magnesium (Mg)	8	mg/100g
Phosphorus (P)	75	mg/100g
Iron (Fe)	0.23	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	0.4	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	<0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	13	µg/100g
Sulphur (S)	58	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.20	mg/100g
Riboflavin	0.05	mg/100g
Niacin	2.3	mg/100g
Tryptophan/60	0.8	mg/100g
Vitamin B ₆	0.09	mg/100g
Folate	4	µg/100g
Pantothenic acid	0.34	mg/100g
Biotin	3.3	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.6	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	0.42	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	0.42	mg/100g
Vitamin D ₃		µg/100g
25-hydroxy vitamin D ₃		µg/100g
Total vitamin D		µg/100g



Sample 6a: Pork leg roasting joint, roasted, lean portion

PROXIMATES

Water	59.8	g/100g
Total Nitrogen	5.33	g/100g
Nitrogen conversion factor	6.25	
Protein	33.3	g/100g
Fat	5.9	g/100g
Ash	3.3	g/100g
Energy (kcal)	186	kcal/100g
Energy (kJ)	784	kJ/100g
Cholesterol	95	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	2.04	g/100g
cis-monounsaturated	2.54	g/100g
cis n-3 polyunsaturated	0.05	g/100g
cis n-6 polyunsaturated	0.66	g/100g
cis polyunsaturated	0.72	g/100g
Trans	0.01	g/100g

INORGANICS

Sodium (Na)	58	mg/100g
Potassium (K)	387	mg/100g
Calcium (Ca)	6	mg/100g
Magnesium (Mg)	29	mg/100g
Phosphorus (P)	236	mg/100g
Iron (Fe)	0.98	mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)	2.8	mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)	0.01	mg/100g
Iodine (I)	<1	µg/100g
Selenium (Se)	28	µg/100g
Sulphur (S)	309	mg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.58	mg/100g
Riboflavin	0.26	mg/100g
Niacin	11.1	mg/100g
Tryptophan/60	7.2	mg/100g
Vitamin B ₆	0.17	mg/100g
Folate	<5	µg/100g
Pantothenic acid	1.00	mg/100g
Biotin	6.7	µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂	0.4	µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol	<0.08	mg/100g
Beta-tocopherol	<0.5	mg/100g
Delta-tocopherol	<0.5	mg/100g
Gamma-tocopherol	<0.5	mg/100g
Vitamin E	<0.08	mg/100g
Vitamin D ₃	0.17	µg/100g
25-hydroxy vitamin D ₃	0.16	µg/100g
Total vitamin D	1.0	µg/100g



Sample 6b: Pork leg roasting joint, roasted, fat portion

PROXIMATES

Water	31.4	g/100g
Total Nitrogen	2.13	g/100g
Nitrogen conversion factor	6.25	
Protein	13.3	g/100g
Fat	59.4	g/100g
Ash		g/100g
Energy (kcal)	588	kcal/100g
Energy (kJ)	2424	kJ/100g
Cholesterol		mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Starch		g/100g
Resistant starch		g/100g
Phytic acid		g/100g
Total sugars		g/100g
Oligosaccharides		g/100g
¹ Available carbohydrate		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated		g/100g
cis-monounsaturated		g/100g
cis n-3 polyunsaturated		g/100g
cis n-6 polyunsaturated		g/100g
cis polyunsaturated		g/100g
Trans		g/100g

INORGANICS

Sodium (Na)		mg/100g
Potassium (K)		mg/100g
Calcium (Ca)		mg/100g
Magnesium (Mg)		mg/100g
Phosphorus (P)		mg/100g
Iron (Fe)		mg/100g
Copper (Cu)		mg/100g
Zinc (Zn)		mg/100g
Chloride (Cl)		mg/100g
Manganese (Mn)		mg/100g
Iodine (I)		µg/100g
Selenium (Se)		µg/100g
Sulphur (S)		mg/100g

WATER SOLUBLE VITAMINS

Thiamin		mg/100g
Riboflavin		mg/100g
Niacin		mg/100g
Tryptophan/60		mg/100g
Vitamin B ₆		mg/100g
Folate		µg/100g
Pantothenic acid		mg/100g
Biotin		µg/100g
Vitamin C		mg/100g
Vitamin B ₁₂		µg/100g

FAT SOLUBLE VITAMINS

Alpha-tocopherol		mg/100g
Beta-tocopherol		mg/100g
Delta-tocopherol		mg/100g
Gamma-tocopherol		mg/100g
Vitamin E		mg/100g
Vitamin D ₃	0.90	µg/100g
25-hydroxy vitamin D ₃	0.24	µg/100g
Total vitamin D	2.1	µg/100g



Analytical methods and Quality Assurance

Eurofins Laboratories are UKAS accredited according to ISO 17025 and follow standard operating procedures to assure quality of data reported. Technical University of Denmark (DTU) is accredited according to ISO 17025 for a wide range of chemical analysis of food. Campden BRI Ltd. are accredited to ISO 17025. Listed below are details of the analytical methods used in the analysis of proximates, vitamins and minerals, and where available the Proficiency Testing (PT) scheme pass rates. It should be noted that Z-Scores are confidential to the laboratories and are not available for sharing publicly.

Moisture:

A homogenised portion of the sample is mixed with sand and heated to 102°C. The moisture loss is determined gravimetrically. Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680 Ref: BS 4401 pt3:1997 LOQ 0.1 g/100g
PT scheme pass rate: 96.55% pass

Ash:

A homogenised portion of the sample is ashed in a muffle furnace at 550°C. The ash is determined gravimetrically. Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680 Ref: BS 4401 pt11:1998 LOQ 0.1 g/100g
PT scheme pass rate: 92.11% pass

Protein:

Protein is measured according to the Kjeldahl method. The sample is digested in sulphuric acid, all proteinaceous nitrogen is converted to ammonia by the addition of alkali and total nitrogen determined by titration. Protein is estimated as N x6.25. The crude protein is calculated by multiplying by the appropriate conversion factor. Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680 LOQ 0.6 g/100g

Fat:

The sample is acid hydrolysed with hydrochloric acid, cooled, filtered and dried. The fat is extracted from the residue with petroleum ether and the dried fat determined gravimetrically. Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680 Ref: BS 4401 pt4:1970 (Weibull Stoldt) LOQ 0.5 g/100g
PT scheme pass rate: 94.28% pass



Fatty acids:

The lipid fractions of the sample are solvent extracted. The isolated fat is transesterified with methanolic sodium methoxide to form fatty acid methyl esters (FAMES). The FAME profile is determined using capillary gas chromatography (GC). Quantification and identification of individual FAMES in the test material is achieved with reference to calibration standards.

Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680 LOQ 0.01 mg/100g
PT scheme pass rate: 98.58% pass

Cholesterol:

Lipid in sample is saponified at high temperature with ethanolic KOH solution. Unsaponifiable fraction containing cholesterol and other sterols is extracted with toluene. Sterols are derivatized to trimethylsilyl (TMS) ethers and then quantified by GC.

LOQ 2 mg/100 g

Reproducibility 20%

Reference Method ISO 6799: 1992

Inorganics:**Sodium**

The sample is microwave digested in acid and determined by ICP-OES.

Accredited to: BS/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 0.01g/100g

PT scheme pass rate: 92.86% pass

Potassium

ICP-OES

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 0.005g/100g

PT scheme pass rate: 95.65% pass

Magnesium

ICP-OES

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 0.0005g/100g

PT scheme pass rate: 100% pass



Phosphorus

ICP-OES

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 0.0002g/100g

PT scheme pass rate: 92% pass

Calcium

Samples are digested by acid solutions in sealed tubes using heat and pressure in a microwave accelerated reaction system. Sample digest solutions are then analysed by ICP-OES. All metals in the aspirated solution are atomised and electronically excited in the plasma. On return to a lower electronic state, electromagnetic radiation with wavelengths characteristic of particular elements is emitted. The radiation is dispersed by an echelle grating and detected by a Charge Injection device (CID). The intensity of emission at the chosen wavelength is directly proportional to the number of atoms of the element present, which in turn is proportional to the concentration in solution.

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 0.0005g/100g

PT scheme pass rate: 92% pass

Iron

ICP-OES

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 0.0005g/100g

PT scheme pass rate: 87.5% pass

Zinc

ICP-OES

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 2mg/kg

PT scheme pass rate: 95.65% pass

Manganese

ICP-OES

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/003)

LOQ 0.6mg/kg

PT scheme pass rate: 100% pass

Iodine



ICP-MS

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

Ref: Internal (ICP/002)

LOQ: 0.01 mg/kg

PT scheme pass rate: 100% pass

Selenium

Microwave assisted digestion followed by ICP-MS.

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

LOQ: 0.002 mg/kg

PT scheme pass rate: 100% pass

Selenium

Microwave assisted digestion followed by ICP-MS.

Accredited to: BS EN ISO/IEC 17025:2005 UKAS 0342

Ref: Internal (ICPMS/010)

LOQ: 0.002mg/kg

Iodine

ICP-MS

Accredited to: BS EN ISO/IEC 17025:2005 UKAS 0342

Ref: Internal (ICPMS/002)

LOQ: 0.01mg/kg

Sulphur

ICP-OES

Accredited to: S/EN ISO/IEC 17025:2005. UKAS 0342

LOQ: 7.2 mg/kg

Oil Soluble Vitamins:

Vitamin D

The samples are saponified, cleaned up by liquid-liquid and SPE-extraction, and derivatised before detection and quantification by LC-MS/MS by stable isotope-technique. The method is run accredited to ISO/IEC 17025:2005, DANAK Test Reg. no 350.

The method is described in detail by Barnkob LL, Petersen PM, Nielsen JP & Jakobsen J (2019): Vitamin D enhanced pork from pigs exposed to artificial UVB light in indoor facilities. European Food Research and Technology. 245; 411-418. DOI: 10.1007/s00217-018-3173-6.

LOQ 0.05 µg/100g

Standard deviation: <10%

FAPAS or no other organisation offer vitamin D3 or 25OHD3 in meat. But NIST 1546a (Meat) and in-house reference material (used since 2014) were analysed, and results within limits for vitamin D3 and 25OHD3.



Vitamin E

Vitamin E is released from the sample by alkaline hydrolysis using ethanolic potassium hydroxide solution and extracted three times with hexane:ethylacetate (85:15 v/v). The determination is carried out by np-HPLC with FLD detection (Ex/EM 290 nm/327nm). For quantification a 3-point calibration curve is used.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: EN 12822:2014

LOQ: 0.080 mg/100g

The total vitamin E figure takes into account the relative biological activities of the different isomers. Vitamin E is given as mg/100g of α - tocopherol equivalent. The activities used for these calculations are as shown below:

α – tocopherol	1.0
β – tocopherol	0.4
γ – tocopherol	0.1
δ – tocopherol	0.01

Water Soluble Vitamins:

Thiamin

Vitamin B1 is extracted from the sample in an autoclave using acid hydrolysis and quantified by rp-HPLC with fluorometric detection (Ex.:36nm, EM: 440nm) after post-column oxidation to thiochrome.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: EN 14122:2003

LOQ: 0.015mg/100g

Riboflavin

Vitamin B2 is extracted from the sample in an autoclave using acid hydrolysis and quantified by rp-HPLC with fluorometric detection (Ex: 468 nm, Em 520 nm). For quantification a 3-point calibration curve is used. The calibration standards used are pure compounds from Sigma, purity > 98 %. The concentration of the standards is for each calibration determined by spectrophotometric measurement (Vitamin B2 UV 444 nm)

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: EN 14152:2003

LOQ: 0.010mg/100g

Niacin

Nicotinic acid and nicotinamide are extracted from samples in a weak hydrochloric acid solution at 100 °C. Afterwards, the pH is adjusted to 4.5 with



a sodium acetate solution and then filtered to vial. Nicotinic acid and nicotinamide are separated by RP-HPLC and detected by fluorometric detection (Ex:322 nm, Em 380 nm) after a post column reaction with hydrogen peroxide catalyzed by Cu(II) ions under UV-radiation (365 nm). Nicotinic acid and nicotinamide are quantified by a 5 point calibration. The concentration of calibration standards are determined by spectrophotometric measurement (260 nm). Niacin is calculated as the sum of nicotinic acid and nicotinamide.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: EN 15652:2009

LOQ: 0.10mg/100g

Tryptophan

LC-FLD

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: EU 152/2009

LOQ: 0.010µg/100g

Vitamin B6

Vitamin B6 is extracted followed by enzymatic dephosphorylation. By reaction with glyoxylic acid in the presence of Fe²⁺ as catalyst, pyridoxamine is transformed into pyridoxal, which is then reduced to pyridoxine by the action of sodium borohydride in alkaline medium. Pyridoxine is finally quantified by RP-HPLC with fluorometric detection (Ex: 290 NM, Em: 395 nm) For quantification a 3-point calibration curve is used. The calibration standards used are pure compounds from Sigma, purity > 98 %. The concentration of the standards for each calibration is determined by spectrophotometric measurement (Vitamin B6 UV 288 nm). Vitamin supplements are not treated with enzymes.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: EN 14164:2014

LOQ: 0.010mg/100g

Vitamin B12

Vitamin B12 is extracted from the sample in an autoclave using a buffered solution. After dilution with basal medium (containing all required growth nutrients except cobalamin) the growth response of *Lactobacillus leichmanii* (ATCC 7830) to extracted cobalamin is measured turbidimetrically. This is compared to calibration solutions with known concentrations.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: AOAC 952.20

LOQ: 0.010µg/100g

Folate

Folate (including folic acid) is extracted from the sample in an autoclave using a buffer solution, followed by an enzymatic digestion with human plasma and pancreas V and finally by a second autoclave treatment. After dilution with



basal medium containing all required growth nutrients except folic acid the growth response of *Lactobacillus rhamnosus* (ATCC 7469) to extracted folate is measured turbidimetrically and is compared to calibration solutions with known concentrations.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: NMKL 111:1985

LOQ: 5.0µg/100g

Pantothenic acid

Pantothenic acid is extracted from the sample in an autoclave using a buffer solution. After dilution with basal medium containing all required growth nutrients except pantothenic acid the growth response of *Lactobacillus plantarum* (ATCC 8014) to extracted pantothenic acid is measured turbidimetrically and is compared to calibration solutions with known concentrations.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: AOAC 945.74/45.2.05 (1990)

LOQ: 0.007mg/100g

Biotin

Biotin is extracted from the sample in an autoclave using acid hydrolysis. After dilution with basal medium containing all required growth nutrients except biotin the growth response of *Lactobacillus plantarum* (ATCC 8014) to extracted biotin is measured turbidimetrically and is compared to calibration solutions with known concentrations.

Accredited to: DS EN ISO/IEC 17025 DANAK 581

Ref: analog. To FDA method. LST AB 266.1, 1995

LOQ: 1.0µg/100g

Biotin in uncooked pork fat samples was determined by LC MS using a specific immune assay clean up. The method was optimised for high fat samples.

