Nutrient analysis of eggs

Analytical Report (revised version)

Prepared by the Institute of Food Research

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Executive summary

The Department of Health undertakes a rolling programme of nutrient analysis surveys to ensure that reliable, up-to-date information on the nutritional value of foods is available for use in conjunction with food composition data collected in dietary surveys to monitor the nutritional value of the nation's diet. Therefore, these nutrient surveys need to provide a single, robust set of nutrient values that is indicative of the potentially broad choice available to the consumer when selecting any particular type of food. As a result, composite samples made up of a number of different types of chicken egg (enriched cage, barn, free range and organic) have been analysed for this survey rather than samples made up of single types.

The aim of this survey was to provide up-to-date nutrient composition data for chicken eggs to reflect changes in chicken feed and egg production methods. 8 composite samples (made up of 12 sub-samples representative of eggs consumed in the UK) were analysed for a range of nutrients. Sub-samples included enriched cage eggs, free range eggs, barn eggs and organic eggs in proportion to market share.

Analytical results from this project have been published previously. This revised report includes:

- Corrected vitamin K data for all composites except composite 1 (eggs, chicken, whole, raw) following anomalies in this data discovered following initial publication

The results from this analytical survey will update the information currently held by providing composition data that reflects changes in hens' diets since eggs were last analysed. The results will be incorporated into the Department of Health's[1] nutrient databank that supports dietary surveys and will be also be disseminated via the authoritative UK food composition tables, *McCance and Widdowson's The Composition of Foods*.

Results for individual fatty acids are reported separately in electronic format. Details of sampling procedures are contained in a separate report.

Methods

A list of composite samples to be analysed was finalised following consultation with the British Egg Industry Council (BEIC) and expert users of UK food composition data (including representatives of the food industry, academia, catering suppliers, nutritionists and dietitians). Sub-samples included in composites were based on market share information provided by BEIC. To extend the scope of the survey BEIC funded the analysis of amino acids, vitamin A (retinol and carotenoids), vitamin D, vitamin E, vitamin K and choline.

Eggs were collected from three large regional packing centres between 22 and 25 March 2011 and prepared for analysis between 28 March 2011 and the 14 April 2011. Sampling from regional packing centres provided a representative sample covering eggs supplied to all the major retailers, the foodservice and food processing industries.

Eggs were combined into 8 composite samples for analysis. Each composite comprised 50% medium sized and 50% large sized eggs of varying age. Each composite was made up of 12 sub-samples of equivalent weight. Samples requiring cooking were prepared in accordance with guidelines produced by the BEIC (http://www.eggrecipes.co.uk). Composites were analysed for proximates, individual fatty acids, amino acids and choline between May and July 2011, and analysed for inorganics and vitamins between May and September 2011. A full list of the composite food samples analysed is given on page 7.

Composite sample list

Full details of sub-samples are in the project sampling report, available as a separate document. This table lists the 8 composite samples prepared and analysed.

Sample Number	Sample Name	Description
1	Eggs, chicken, whole, raw	12 sub samples from 3 UK egg distribution centres, including enriched cage, barn, free-range and organic
2	Eggs, chicken, white, raw	12 sub samples from 3 egg distribution centres, including enriched cage, barn, free-range and organic
3	Eggs, chicken, yolk, raw	12 sub samples from 3 egg distribution centres, including enriched cage, barn, free-range and organic
4	Eggs, chicken, whole, boiled	12 sub samples from 3 egg distribution centres, including enriched cage, barn, free-range and organic
5	Eggs, chicken, white, boiled	12 sub samples from 3 egg distribution centres, including enriched cage, barn, free-range and organic
6	Eggs, chicken, yolk, boiled	12 sub samples from 3 egg distribution centres, including enriched cage, barn, free-range and organic
7	Eggs, chicken, whole, poached	12 sub samples from 3 egg distribution centres, including enriched cage, barn, free-range and organic
8	Eggs, chicken, whole, fried in sunflower oil	12 sub samples from 3 egg distribution centres, including enriched cage, barn, free-range and organic

Analysis and results

Notes relating to analysis

- Available carbohydrate, starch, total sugars and individual sugars are reported as monosaccharide equivalents. The following factors were used to convert from carbohydrate weights to monosaccharide equivalents:

o Monosaccharides:	no conversion
o Disaccharides:	x 1.05
o Oligosaccharides	
Trisaccharides	x 1.07
Tetrasaccharides	x 1.08
Pentasaccharides	x 1.09
o Starch	x 1.10

- Total carbohydrate was reported as ‘available carbohydrate’ calculated from the sum of free sugars (glucose, fructose, sucrose, maltose, lactose, galactose and oligosaccharides) and complex carbohydrates (dextrins, starch)
- 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
o Protein	4	17
o Fat	9	37
o 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 6th Summary edition of McCance and Widdowson's The Composition of Foods.

Results for individual fatty acids are available separately in electronic format.

- Total vitamin A is calculated as retinol equivalents and is equal to retinol + (beta-carotene equivalents/6)
- Retinol is calculated as all trans retinol + (0.75 x 13-cis retinol)
- Total carotene is expressed as beta-carotene equivalents and is calculated as beta-carotene + (alpha-carotene + beta-cryptoxanthin)/2
- Beta-carotene is expressed as the sum of trans and cis-beta carotene
- Total vitamin D is calculated as vitamin D3 + (25OH vitamin D3 * 5)
- Total vitamin E is expressed as a-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'
- Analysis of proximates, individual fatty acids, amino acids and choline was performed by Eurofins laboratories between May and July 2011. Analysis of inorganics and vitamins was performed by LGC between May and September 2011.

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.

Analytical Results

Sample 1: Eggs, chicken, whole, raw

PROXIMATES

Water	76.8	g/100g
Total Nitrogen	2.02	g/100g
Nitrogen conversion factor	6.25	
Protein	12.6	g/100g
Fat	9.0	g/100g
Ash	0.8	g/100g
Energy (kcal)	131	
Energy (kJ)	547	
Cholesterol	350	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Galactose		g/100g
Starch		g/100g
Total sugars		g/100g
Available carbohydrate		g/100g
Fibre (Englyst)		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	2.52	g/100g
cis-monounsaturated	3.43	g/100g
cis n-3 polyunsaturated	0.13	g/100g
cis n-6 polyunsaturated	1.31	g/100g
cis polyunsaturated	1.44	g/100g
Trans	0.01	g/100g

INORGANICS

Sodium (Na)	154	mg/100g
Potassium (K)	145	mg/100g
Calcium (Ca)	46	mg/100g
Magnesium (Mg)	13	mg/100g
Phosphorus (P)	179	mg/100g
Iron (Fe)	1.72	mg/100g
Copper (Cu)	0.05	mg/100g
Zinc (Zn)	1.12	mg/100g
Chloride (Cl)	180	mg/100g
Manganese (Mn)	0.03	mg/100g
Iodine (I)	50	µg/100g
Selenium (Se)	23	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.08	mg/100g
Riboflavin	0.50	mg/100g
Niacin	0.05	mg/100g
Tryptophan/60	3.4	mg/100g
Vitamin B_6	0.13	mg/100g
Vitamin B_{12}	2.7	µg/100g
Folate	47	µg/100g
Pantothenic acid	1.35	mg/100g
Biotin	19.5	µg/100g
Vitamin C		mg/100g
Choline	285	mg/100g
Choline Chloride	382	mg/100g

Sample 1: Eggs, chicken, whole, raw

FAT SOLUBLE VITAMINS

Retinol	126	µg/100g
Alpha-carotene	<1	µg/100g
Beta-carotene	<1	µg/100g
Cryptoxanthins	<1	µg/100g
Total carotene	<1	µg/100g
Total Vitamin A	126	µg/100g
Lutein	94	µg/100g
Lycopene	<1	µg/100g
Zeaxanthin	7	µg/100g
Vitamin D3	2.5	µg/100g
25-OH vitamin D3	0.13	µg/100g
Total vitamin D	3.15	µg/100g
Alpha-tocopherol	1.23	mg/100g
Beta-tocopherol	0.05	mg/100g
Delta-tocopherol	<0.01	mg/100g
Gamma-tocopherol	0.24	mg/100g
Alpha-tocotrienol	0.04	mg/100g
Gamma-tocotrienol	0.02	mg/100g
Total vitamin E	1.29	mg/100g
Vitamin K1	<6	µg/100g
Vitamin K2	7.0	µg/100g

AMINO ACIDS

Isoleucine	684	mg/100g
Leucine	1120	mg/100g
Lysine	922	mg/100g
Methionine	424	mg/100g
Cystein + Cystine	311	mg/100g
Phenylalanine	711	mg/100g
Tyrosine	536	mg/100g
Threonine	609	mg/100g
Tryptophan	193	mg/100g
Valine	824	mg/100g
Arginine	798	mg/100g
Histidine	309	mg/100g
Alanine	726	mg/100g
Aspartic acid	1300	mg/100g
Glutamic acid	1650	mg/100g
Glycine	432	mg/100g
Proline	546	mg/100g
Serine	929	mg/100g

Sample 2: Eggs, chicken, white, raw

PROXIMATES

Water	87.3	g/100g
Total Nitrogen	1.73	g/100g
Nitrogen conversion factor	6.25	
Protein	10.8	g/100g
Fat	<0.5	g/100g
Ash	0.7	g/100g
Energy (kcal)	43	
Energy (kJ)	184	
Cholesterol		mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Galactose		g/100g
Starch		g/100g
Total sugars		g/100g
Available carbohydrate		g/100g
Fibre (Englyst)		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	<0.2	g/100g
cis-monounsaturated	<0.2	g/100g
cis n-3 polyunsaturated	<0.2	g/100g
cis n-6 polyunsaturated	<0.2	g/100g
cis polyunsaturated	<0.2	g/100g
Trans	<0.2	g/100g

INORGANICS

Sodium (Na)	185	mg/100g
Potassium (K)	149	mg/100g
Calcium (Ca)	6	mg/100g
Magnesium (Mg)	12	mg/100g
Phosphorus (P)	12	mg/100g
Iron (Fe)	0.01	mg/100g
Copper (Cu)	0.02	mg/100g
Zinc (Zn)	0.01	mg/100g
Chloride (Cl)	159	mg/100g
Manganese (Mn)	<0.01	mg/100g
Iodine (I)	4	µg/100g
Selenium (Se)	8	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.02	mg/100g
Riboflavin	0.42	mg/100g
Niacin	0.04	mg/100g
Tryptophan/60	2.8	mg/100g
Vitamin B_6	0.04	mg/100g
Vitamin B_{12}	0.33	µg/100g
Folate	10	µg/100g
Pantothenic acid	0.28	mg/100g
Biotin	5.6	µg/100g
Vitamin C		mg/100g
Choline	1.12	mg/100g
Choline Chloride	1.50	mg/100g

Sample 2: Eggs, chicken, white, raw

FAT SOLUBLE VITAMINS

Retinol		µg/100g
Alpha-carotene		µg/100g
Beta-carotene		µg/100g
Cryptoxanthins		µg/100g
Total carotene		µg/100g
Total Vitamin A		µg/100g
Lutein		µg/100g
Lycopene		µg/100g
Zeaxanthin		µg/100g
Vitamin D3		µg/100g
25-OH vitamin D3		µg/100g
Total vitamin D		µg/100g
Alpha-tocopherol		mg/100g
Beta-tocopherol		mg/100g
Delta-tocopherol		mg/100g
Gamma-tocopherol		mg/100g
Alpha-tocotrienol		mg/100g
Gamma-tocotrienol		mg/100g
Total vitamin E		mg/100g
Vitamin K1		µg/100g
Vitamin K2		µg/100g

AMINO ACIDS

Isoleucine	617	mg/100g
Leucine	997	mg/100g
Lysine	804	mg/100g
Methionine	423	mg/100g
Cystein + Cystine	322	mg/100g
Phenylalanine	716	mg/100g
Tyrosine	471	mg/100g
Threonine	528	mg/100g
Tryptophan	173	mg/100g
Valine	787	mg/100g
Arginine	659	mg/100g
Histidine	271	mg/100g
Alanine	694	mg/100g
Aspartic acid	1210	mg/100g
Glutamic acid	1540	mg/100g
Glycine	410	mg/100g
Proline	506	mg/100g
Serine	787	mg/100g

Sample 3: Eggs, chicken, yolk, raw

PROXIMATES

Water	48.8	g/100g
Total Nitrogen	2.62	g/100g
Nitrogen conversion factor	6.25	
Protein	16.4	g/100g
Fat	31.3	g/100g
Ash	1.6	g/100g
Energy (kcal)	347	
Energy (kJ)	1437	
Cholesterol	1255	mg/100g

CARBOHYDRATES

Glucose	g/100g
Fructose	g/100g
Sucrose	g/100g
Maltose	g/100g
Lactose	g/100g
Galactose	g/100g
Starch	g/100g
Total sugars	g/100g
Available carbohydrate	g/100g
Fibre (Englyst)	g/100g
Fibre (AOAC)	g/100g

FATTY ACIDS

Saturated	8.81	g/100g
cis-monounsaturated	11.98	g/100g
cis n-3 polyunsaturated	0.45	g/100g
cis n-6 polyunsaturated	4.52	g/100g
cis polyunsaturated	4.97	g/100g
Trans	0.05	g/100g

INORGANICS

Sodium (Na)	52	mg/100g
Potassium (K)	124	mg/100g
Calcium (Ca)	149	mg/100g
Magnesium (Mg)	12	mg/100g
Phosphorus (P)	600	mg/100g
Iron (Fe)	6.24	mg/100g
Copper (Cu)	0.16	mg/100g
Zinc (Zn)	4.03	mg/100g
Chloride (Cl)	163	mg/100g
Manganese (Mn)	0.11	mg/100g
Iodine (I)	130	µg/100g
Selenium (Se)	59	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.20	mg/100g
Riboflavin	0.59	mg/100g
Niacin	0.04	mg/100g
Tryptophan/60	2.8	mg/100g
Vitamin B_6	0.35	mg/100g
Vitamin B_{12}	8.21	µg/100g
Folate	122	µg/100g
Pantothenic acid	4.53	mg/100g
Biotin	63.6	µg/100g
Vitamin C		mg/100g
Choline	711	mg/100g
Choline Chloride	954	mg/100g

Sample 3: Eggs, chicken, yolk, raw

FAT SOLUBLE VITAMINS

Retinol	447	µg/100g
Alpha-carotene	<1	µg/100g
Beta-carotene	<1	µg/100g
Cryptoxanthins	<1	µg/100g
Total carotene	<1	µg/100g
Total Vitamin A	447	µg/100g
Lutein	575	µg/100g
Lycopene	<1	µg/100g
Zeaxanthin	96	µg/100g
Vitamin D3	11.0	µg/100g
25-OH vitamin D3	0.36	µg/100g
Total vitamin D	12.80	µg/100g
Alpha-tocopherol	5.16	mg/100g
Beta-tocopherol	<0.01	mg/100g
Delta-tocopherol	<0.01	mg/100g
Gamma-tocopherol	<0.01	mg/100g
Alpha-tocotrienol	0.15	mg/100g
Gamma-tocotrienol	<0.01	mg/100g
Total vitamin E	5.21	mg/100g
Vitamin K1	<6	µg/100g
Vitamin K2	15.00	µg/100g

AMINO ACIDS

Isoleucine	809	mg/100g
Leucine	1400	mg/100g
Lysine	1230	mg/100g
Methionine	388	mg/100g
Cystein + Cystine	282	mg/100g
Phenylalanine	683	mg/100g
Tyrosine	727	mg/100g
Threonine	824	mg/100g
Tryptophan	234	mg/100g
Valine	894	mg/100g
Arginine	1150	mg/100g
Histidine	398	mg/100g
Alanine	818	mg/100g
Aspartic acid	1510	mg/100g
Glutamic acid	1940	mg/100g
Glycine	483	mg/100g
Proline	660	mg/100g
Serine	1340	mg/100g

Sample 4: Eggs, chicken, whole, boiled

PROXIMATES

Water	75.4	g/100g
Total Nitrogen	2.26	g/100g
Nitrogen conversion factor	6.25	
Protein	14.1	g/100g
Fat	9.6	g/100g
Ash	0.9	g/100g
Energy (kcal)	143	
Energy (kJ)	595	
Cholesterol	360	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Galactose		g/100g
Starch		g/100g
Total sugars		g/100g
Available carbohydrate		g/100g
Fibre (Englyst)		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	2.70	g/100g
cis-monounsaturated	3.67	g/100g
cis n-3 polyunsaturated	0.14	g/100g
cis n-6 polyunsaturated	1.38	g/100g
cis polyunsaturated	1.51	g/100g
Trans	0.01	g/100g

INORGANICS

Sodium (Na)	150	mg/100g
Potassium (K)	141	mg/100g
Calcium (Ca)	55	mg/100g
Magnesium (Mg)	14	mg/100g
Phosphorus (P)	205	mg/100g
Iron (Fe)	1.97	mg/100g
Copper (Cu)	0.07	mg/100g
Zinc (Zn)	1.32	mg/100g
Chloride (Cl)	179	mg/100g
Manganese (Mn)	0.04	mg/100g
Iodine (I)	52	µg/100g
Selenium (Se)	27	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.08	mg/100g
Riboflavin	0.47	mg/100g
Niacin	0.08	mg/100g
Tryptophan/60	3.6	mg/100g
Vitamin B_6	0.10	mg/100g
Vitamin B_{12}	2.0	µg/100g
Folate	30	µg/100g
Pantothenic acid	1.25	mg/100g
Biotin	16.7	µg/100g
Vitamin C		mg/100g
Choline	276	mg/100g
Choline Chloride	371	mg/100g

Sample 4: Eggs, chicken, whole, boiled

FAT SOLUBLE VITAMINS

Retinol	120	µg/100g
Alpha-carotene	<1	µg/100g
Beta-carotene	<1	µg/100g
Cryptoxanthins	<1	µg/100g
Total carotene	<1	µg/100g
Total Vitamin A	120	µg/100g
Lutein	97	µg/100g
Lycopene	<1	µg/100g
Zeaxanthin	2	µg/100g
Vitamin D3	2.3	µg/100g
25-OH vitamin D3	0.18	µg/100g
Total vitamin D	3.20	µg/100g
Alpha-tocopherol	1.56	mg/100g
Beta-tocopherol	0.03	mg/100g
Delta-tocopherol	<0.01	mg/100g
Gamma-tocopherol	0.42	mg/100g
Alpha-tocotrienol	0.05	mg/100g
Gamma-tocotrienol	<0.01	mg/100g
Total vitamin E	1.63	mg/100g
Vitamin K1	<6	µg/100g
Vitamin K2	5.0	µg/100g

AMINO ACIDS

Isoleucine	683	mg/100g
Leucine	1140	mg/100g
Lysine	941	mg/100g
Methionine	455	mg/100g
Cystein + Cystine	309	mg/100g
Phenylalanine	719	mg/100g
Tyrosine	540	mg/100g
Threonine	629	mg/100g
Tryptophan	207	mg/100g
Valine	820	mg/100g
Arginine	825	mg/100g
Histidine	311	mg/100g
Alanine	734	mg/100g
Aspartic acid	1320	mg/100g
Glutamic acid	1670	mg/100g
Glycine	439	mg/100g
Proline	544	mg/100g
Serine	968	mg/100g

Sample 5: Eggs, chicken, white, boiled

PROXIMATES

Water	85.8	g/100g
Total Nitrogen	2.08	g/100g
Nitrogen conversion factor	6.25	
Protein	13.0	g/100g
Fat		g/100g
Ash	0.7	g/100g
Energy (kcal)	52	
Energy (kJ)	221	
Cholesterol		mg/100g

CARBOHYDRATES

Glucose	g/100g
Fructose	g/100g
Sucrose	g/100g
Maltose	g/100g
Lactose	g/100g
Galactose	g/100g
Starch	g/100g
Total sugars	g/100g
Available carbohydrate	g/100g
Fibre (Englyst)	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)	151	mg/100g
Potassium (K)	123	mg/100g
Calcium (Ca)	8	mg/100g
Magnesium (Mg)	12	mg/100g
Phosphorus (P)	13	mg/100g
Iron (Fe)	0.05	mg/100g
Copper (Cu)	0.04	mg/100g
Zinc (Zn)	0.10	mg/100g
Chloride (Cl)	164	mg/100g
Manganese (Mn)	<0.01	mg/100g
Iodine (I)	4	µg/100g
Selenium (Se)	11	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.03	mg/100g
Riboflavin	0.20	mg/100g
Niacin	0.06	mg/100g
Tryptophan/60	4.0	mg/100g
Vitamin B_6	0.03	mg/100g
Vitamin B_{12}	0.53	µg/100g
Folate	4	µg/100g
Pantothenic acid	0.22	mg/100g
Biotin	3.2	µg/100g
Vitamin C		mg/100g
Choline	1.18	mg/100g
Choline Chloride	1.60	mg/100g

Sample 5: Eggs, chicken, white, boiled

FAT SOLUBLE VITAMINS

Retinol		µg/100g
Alpha-carotene		µg/100g
Beta-carotene		µg/100g
Cryptoxanthins		µg/100g
Total carotene		µg/100g
Total Vitamin A		µg/100g
Lutein		µg/100g
Lycopene		µg/100g
Zeaxanthin		µg/100g
Vitamin D3		µg/100g
25-OH vitamin D3		µg/100g
Total vitamin D		µg/100g
Alpha-tocopherol		mg/100g
Beta-tocopherol		mg/100g
Delta-tocopherol		mg/100g
Gamma-tocopherol		mg/100g
Alpha-tocotrienol		mg/100g
Gamma-tocotrienol		mg/100g
Total vitamin E		mg/100g
Vitamin K1		µg/100g
Vitamin K2		µg/100g

AMINO ACIDS

Isoleucine	745	mg/100g
Leucine	1210	mg/100g
Lysine	973	mg/100g
Methionine	532	mg/100g
Cystein + Cystine	355	mg/100g
Phenylalanine	871	mg/100g
Tyrosine	546	mg/100g
Threonine	639	mg/100g
Tryptophan	205	mg/100g
Valine	940	mg/100g
Arginine	805	mg/100g
Histidine	327	mg/100g
Alanine	838	mg/100g
Aspartic acid	1450	mg/100g
Glutamic acid	1850	mg/100g
Glycine	496	mg/100g
Proline	576	mg/100g
Serine	963	mg/100g

Sample 6: Eggs, chicken, yolk, boiled

PROXIMATES

Water	47.2	g/100g
Total Nitrogen	2.67	g/100g
Nitrogen conversion factor	6.25	
Protein	16.7	g/100g
Fat	32.6	g/100g
Ash	2.0	g/100g
Energy (kcal)	360	
Energy (kJ)	1490	
Cholesterol	1175	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Galactose		g/100g
Starch		g/100g
Total sugars		g/100g
Available carbohydrate		g/100g
Fibre (Englyst)		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	9.21	g/100g
cis-monounsaturated	12.48	g/100g
cis n-3 polyunsaturated	0.47	g/100g
cis n-6 polyunsaturated	4.70	g/100g
cis polyunsaturated	5.17	g/100g
Trans	0.05	g/100g

INORGANICS

Sodium (Na)	52	mg/100g
Potassium (K)	119	mg/100g
Calcium (Ca)	147	mg/100g
Magnesium (Mg)	12	mg/100g
Phosphorus (P)	600	mg/100g
Iron (Fe)	6.21	mg/100g
Copper (Cu)	0.15	mg/100g
Zinc (Zn)	3.90	mg/100g
Chloride (Cl)	180	mg/100g
Manganese (Mn)	0.11	mg/100g
Iodine (I)	137	µg/100g
Selenium (Se)	64	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.19	mg/100g
Riboflavin	0.58	mg/100g
Niacin	0.03	mg/100g
Tryptophan/60	3.0	mg/100g
Vitamin B_6	0.31	mg/100g
Vitamin B_{12}	7.23	µg/100g
Folate	101	µg/100g
Pantothenic acid	3.72	mg/100g
Biotin	50.0	µg/100g
Vitamin C		mg/100g
Choline	826	mg/100g
Choline Chloride	1107	mg/100g

Sample 6: Eggs, chicken, yolk, boiled

FAT SOLUBLE VITAMINS

Retinol	410	µg/100g
Alpha-carotene	<1	µg/100g
Beta-carotene	<1	µg/100g
Cryptoxanthins	<1	µg/100g
Total carotene	<1	µg/100g
Total Vitamin A	410	µg/100g
Lutein	550	µg/100g
Lycopene	<1	µg/100g
Zeaxanthin	93	µg/100g
Vitamin D3	10.8	µg/100g
25-OH vitamin D3	0.35	µg/100g
Total vitamin D	12.55	µg/100g
Alpha-tocopherol	4.73	mg/100g
Beta-tocopherol	<0.01	mg/100g
Delta-tocopherol	<0.01	mg/100g
Gamma-tocopherol	<0.01	mg/100g
Alpha-tocotrienol	0.15	mg/100g
Gamma-tocotrienol	<0.01	mg/100g
Total vitamin E	4.78	mg/100g
Vitamin K1	<6	µg/100g
Vitamin K2	18.0	µg/100g

AMINO ACIDS

Isoleucine	822	mg/100g
Leucine	1390	mg/100g
Lysine	1210	mg/100g
Methionine	373	mg/100g
Cystein + Cystine	259	mg/100g
Phenylalanine	673	mg/100g
Tyrosine	720	mg/100g
Threonine	807	mg/100g
Tryptophan	233	mg/100g
Valine	901	mg/100g
Arginine	1150	mg/100g
Histidine	397	mg/100g
Alanine	803	mg/100g
Aspartic acid	1480	mg/100g
Glutamic acid	1900	mg/100g
Glycine	473	mg/100g
Proline	644	mg/100g
Serine	1290	mg/100g

Sample 7: Eggs, chicken, whole, poached

PROXIMATES

Water	75.3	g/100g
Total Nitrogen	2.13	g/100g
Nitrogen conversion factor	6.25	
Protein	13.3	g/100g
Fat	10.6	g/100g
Ash	0.8	g/100g
Energy (kcal)	149	
Energy (kJ)	618	
Cholesterol	423	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Galactose		g/100g
Starch		g/100g
Total sugars		g/100g
Available carbohydrate		g/100g
Fibre (Englyst)		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	3.00	g/100g
cis-monounsaturated	4.02	g/100g
cis n-3 polyunsaturated	0.15	g/100g
cis n-6 polyunsaturated	1.55	g/100g
cis polyunsaturated	1.70	g/100g
Trans	0.02	g/100g

INORGANICS

Sodium (Na)	121	mg/100g
Potassium (K)	117	mg/100g
Calcium (Ca)	50	mg/100g
Magnesium (Mg)	12	mg/100g
Phosphorus (P)	195	mg/100g
Iron (Fe)	1.93	mg/100g
Copper (Cu)	0.08	mg/100g
Zinc (Zn)	1.25	mg/100g
Chloride (Cl)	138	mg/100g
Manganese (Mn)	0.03	mg/100g
Iodine (I)	54	µg/100g
Selenium (Se)	28	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.09	mg/100g
Riboflavin	0.41	mg/100g
Niacin	0.07	mg/100g
Tryptophan/60	3.2	mg/100g
Vitamin B_6	0.11	mg/100g
Vitamin B_{12}	1.83	µg/100g
Folate	49	µg/100g
Pantothenic acid	1.30	mg/100g
Biotin	15.1	µg/100g
Vitamin C		mg/100g
Choline	311	mg/100g
Choline Chloride	417	mg/100g

Sample 7: Eggs, chicken, whole, poached

FAT SOLUBLE VITAMINS

Retinol	150	µg/100g
Alpha-carotene	<1	µg/100g
Beta-carotene	<1	µg/100g
Cryptoxanthins	<1	µg/100g
Total carotene	<1	µg/100g
Total Vitamin A	150	µg/100g
Lutein	126	µg/100g
Lycopene	<1	µg/100g
Zeaxanthin	13	µg/100g
Vitamin D3	2.3	µg/100g
25-OH vitamin D3	0.12	µg/100g
Total vitamin D	2.9	µg/100g
Alpha-tocopherol	1.73	mg/100g
Beta-tocopherol	0.09	mg/100g
Delta-tocopherol	<0.01	mg/100g
Gamma-tocopherol	0.39	mg/100g
Alpha-tocotrienol	0.05	mg/100g
Gamma-tocotrienol	0.06	mg/100g
Total vitamin E	1.82	mg/100g
Vitamin K1	<6	µg/100g
Vitamin K2	10.0	µg/100g

AMINO ACIDS

Isoleucine	653	mg/100g
Leucine	1130	mg/100g
Lysine	929	mg/100g
Methionine	437	mg/100g
Cystein + Cystine	297	mg/100g
Phenylalanine	710	mg/100g
Tyrosine	527	mg/100g
Threonine	634	mg/100g
Tryptophan	200	mg/100g
Valine	776	mg/100g
Arginine	821	mg/100g
Histidine	305	mg/100g
Alanine	736	mg/100g
Aspartic acid	1310	mg/100g
Glutamic acid	1680	mg/100g
Glycine	436	mg/100g
Proline	498	mg/100g
Serine	1010	mg/100g

Sample 8: Eggs, chicken, whole, fried in sunflower oil

PROXIMATES

Water	68.0	g/100g
Total Nitrogen	2.35	g/100g
Nitrogen conversion factor	6.25	
Protein	14.7	g/100g
Fat	15.7	g/100g
Ash	0.9	g/100g
Energy (kcal)	200	
Energy (kJ)	831	
Cholesterol	371	mg/100g

CARBOHYDRATES

Glucose		g/100g
Fructose		g/100g
Sucrose		g/100g
Maltose		g/100g
Lactose		g/100g
Galactose		g/100g
Starch		g/100g
Total sugars		g/100g
Available carbohydrate		g/100g
Fibre (Englyst)		g/100g
Fibre (AOAC)		g/100g

FATTY ACIDS

Saturated	3.35	g/100g
cis-monounsaturated	5.38	g/100g
cis n-3 polyunsaturated	0.14	g/100g
cis n-6 polyunsaturated	4.06	g/100g
cis polyunsaturated	4.21	g/100g
Trans	0.02	g/100g

INORGANICS

Sodium (Na)	172	mg/100g
Potassium (K)	164	mg/100g
Calcium (Ca)	53	mg/100g
Magnesium (Mg)	14	mg/100g
Phosphorus (P)	209	mg/100g
Iron (Fe)	2.03	mg/100g
Copper (Cu)	0.06	mg/100g
Zinc (Zn)	1.30	mg/100g
Chloride (Cl)	188	mg/100g
Manganese (Mn)	0.03	mg/100g
Iodine (I)	58	µg/100g
Selenium (Se)	27	µg/100g

WATER SOLUBLE VITAMINS

Thiamin	0.06	mg/100g
Riboflavin	0.46	mg/100g
Niacin	0.06	mg/100g
Tryptophan/60	3.5	mg/100g
Vitamin B_6	0.12	mg/100g
Vitamin B_{12}	1.00	µg/100g
Folate	25	µg/100g
Pantothenic acid	1.22	mg/100g
Biotin	18.2	µg/100g
Vitamin C		mg/100g
Choline	302	mg/100g
Choline Chloride	405	mg/100g

Sample 8: Eggs, chicken, whole, fried in sunflower oil

FAT SOLUBLE VITAMINS

Retinol	190	µg/100g
Alpha-carotene	<1	µg/100g
Beta-carotene	<1	µg/100g
Cryptoxanthins	<1	µg/100g
Total carotene	<1	µg/100g
Total Vitamin A	190	µg/100g
Lutein	105	µg/100g
Lycopene	<1	µg/100g
Zeaxanthin	9	µg/100g
Vitamin D3	1.4	µg/100g
25-OH vitamin D3	0.10	µg/100g
Total vitamin D	1.9	µg/100g
Alpha-tocopherol	3.72	mg/100g
Beta-tocopherol	0.17	mg/100g
Delta-tocopherol	<0.01	mg/100g
Gamma-tocopherol	0.38	mg/100g
Alpha-tocotrienol	0.05	mg/100g
Gamma-tocotrienol	0.06	mg/100g
Total vitamin E	3.84	mg/100g
Vitamin K1	<6	µg/100g
Vitamin K2	7.0	µg/100g

AMINO ACIDS

Isoleucine	755	mg/100g
Leucine	1250	mg/100g
Lysine	1030	mg/100g
Methionine	465	mg/100g
Cystein + Cystine	319	mg/100g
Phenylalanine	808	mg/100g
Tyrosine	600	mg/100g
Threonine	699	mg/100g
Tryptophan	221	mg/100g
Valine	914	mg/100g
Arginine	896	mg/100g
Histidine	347	mg/100g
Alanine	827	mg/100g
Aspartic acid	1460	mg/100g
Glutamic acid	1860	mg/100g
Glycine	490	mg/100g
Proline	602	mg/100g
Serine	1080	mg/100g

Analytical Methods

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

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

Protein:
The sample is analysed using Leco instrumentation following the Dumas procedure: The sample is combusted in an oxygen atmosphere, the gaseous product is cleaned and nitrogen compounds converted to nitrogen which is measured by a thermal conductivity cell. The crude protein is calculated by multiplying by the appropriate conversion factor.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
LOQ 0.1 g/100g

Fat:
The sample is acid hydrolysed with hydrochloric acid, cooled, filtered and dried. The fat is extract 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 0.1 g/100g

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

Sugars:
The sugars are extracted with water, clarified and chromatographically separated on an amine column with an acetonitrile/water mobile phase. The sugars are detected using an evaporative light scattering detector and quantified with reference to calibration standards.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
LOQ 0.1 g/100g

Starch:

The method consists of two separate determinations. The sample is treated with warm diluted hydrochloric acid, clarified and filtered; the optical rotation of the resulting solution is determined. In the second determination, the sample is extracted with 40% ethanol and filtered. The filtrate is acidified with hydrochloric acid, clarified and filtered again; the optical rotation of the resulting solution is determined at 20 ±2ºC.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
Ref: The Feeding Stuffs (Sampling and Analysis) Regulations 1982 Method 30a.
LOQ 2 g/100g

Oligosaccharides:
Malto-oligosaccharides (DP1-7) are determined individually by High Performance Anion Exchange Chromatography with Pulsed Amperometric Detection. In-house method
LOQ 0.1 g/100g

Dietary Fibre:
AOAC
The sample is weighed and de-fatted if necessary. It is then gelatinised and treated with α-amylase and further digested enzymatically with protease and amyloglucosidase to remove the starch and protein. The dietary fibre is precipitated with IMS, filtered, washed, dried and weighed. Total dietary fibre is then determined gravimetrically and corrected for protein and ash.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
Ref: AOAC 985.29/45.4.07 (2007)
LOQ 0.5 g/100g

Englyst (Non-starch polysaccharides)
Englyst Fibrezym kit with colorimetric end point
LOQ 0.2 g/100g

Cholesterol:
Method 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 0.7 mg/100 g
Reproducibility 20%
Reference Method ISO 6799: 1992

Inorganics:
Sodium, Potassium, Calcium, Magnesium, Copper, Iron, Manganese, Zinc, Phosphorus, Selenium
Samples are digested in acid under oxidising conditions, using sealed ‘bombs’ in automated microwave digestors, to prevent losses of volatile metals/inorganics, Metals (and some inorganics) are then determined by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) or by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). These techniques allow the sensitive and accurate (true and precise) determination of metals in foods and allow matrix interferences to be overcome.
In house methods - UKAS accredited.

Iodide

Concentrations are determined by high resolution ICP-MS after extraction with tetra methyl ammonium hydroxide.
UKAS accredited.

Chloride
Concentrations are determined using a Corning Chloride Analyser after extraction with nitric acid.
In house method FFF/B1-2104 - UKAS accredited.

Vitamins – Water Soluble:
Thiamin, Riboflavin & Vitamin B6
Thiamin, riboflavin and Vitamin B6 are determined by HPLC after appropriate and controlled acid and enzymatic hydrolysis. The methods are based on published CEN Standards. The selected method enables determination of total B6 as pyridoxine and is most appropriate to samples of this type where pyridoxine or its phosphate will form the major vitamin B6 component.
UKAS accredited.

Niacin, Total Folate, Biotin, Pantothenic acid
Determined using microbiological assay (MBA) procedures with detection carried out using VitaFast® MBA test kits.
UKAS accredited.

Tryptophan
Determined by HPLC using fluorescence detection after alkaline hydrolysis. Tryptophan contributes to the available Niacin on the basis that Niacin = Tryptophan/60.

Vitamin B12
Vitamin B12 is extracted from food by autoclaving in acetate buffer in the presence of cyanide. Vitamin B12 is determined by microbiological assay using *L.Delbrueckii.Lactis.*
UKAS accredited.

The B-vitamin results are expressed as follows:

Thiamin:	thiamin chloride hydrochloride
Riboflavin:	free riboflavin
Niacin:	nicotinic acid
Vitamin B6:	pyridoxine hydrochloride
Pantothenate:	pantothenic acid
Biotin:	d-biotin
B12:	cyanocobalamin
Total folate:	pteroyglutamic acid

Vitamin C
Vitamin C is determined by HPLC using fluorescence detection.

Oil Soluble Vitamins:
Vitamins A, D, E and the carotenoids are determined using an in house procedure involving saponification of the sample, solvent extraction and HPLC determination - UKAS accredited methods based on:

- Vitamin A – Retinol: BS EN 12823-1:2000. Foodstuffs-Determination of Vitamin A by High Performance Liquid Chromatography-Part 1: Measurement of Retinol
- Vitamin A – β-Carotene: BS EN 12823-2:2000. Foodstuffs-Determination of Vitamin A by High Performance Liquid Chromatography-Part 2: Measurement of β-Carotene
- Vitamin D: BS EN 12821:2000. Foodstuffs-Determination of Vitamin D by High Performance Liquid Chromatography-Measurement of Cholecalciferol (D3) and Ergocalciferol (D2)
- Vitamin K: Based on BS EN 14148: Determination of vitamin K1 by HPLC modified to include K2 isomers. After enzymatic removal of fat, vitamin K1 is extracted into organic solvent and is determined by HPLC with post-column reduction and fluorescence detection
- Vitamin E: BS EN 12822:2000. Foodstuffs-Determination of Vitamin E by High Performance Liquid Chromatography-Measurement of α-, β-, γ- and δ-tocopherols.

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

Total vitamin A is expressed as ug/100g all-trans retinol equivalent (ATRE) and is calculated as follows:

All-trans retinol + (0.75*13-cis retinol) +(β-carotene/6) +(other active carotenoids/12)

UKAS accredited.

Choline
Determined by ion-exchange HPLC with conductivity detection

Amino Acids
Determined using an automated amino acid analyser – AACC 07-01, EC Dir. 98/64, ISO 13903:2005.
LOQ 10mg/100g
RSD=2.3-6.9%

Quality Assurance

Eurofins Laboratories followed standard operating procedures to assure quality of data reported. Procedures are described in the documents listed below.

Document No.	Edition	Title/content
AQC/001	7	Procedures for the establishment of internal quality control charts for AQC samples
AQC/005	5	Procedures for the conduct of external proficiency schemes
AQC/006	4	Storage of chemicals, stock solutions & standards and verification of 'critical reagents'
AQC/011	1	Analytical quality control charts for AQC samples, preparation, interpretation and action
SAMP/031	2	Procedure for managing repeat analyses
DATA/009	9	Manual recording of data and data verification
DATA/016	2	Approval of results in eLIMS

Listed below are details of the analytical methods used in the analysis of proximates and fatty acids and the quality control procedures used. Where any proficiency test results from FAPAS are quoted they are from the rounds near to the time at which analysis was carried out.

Q/005: The determination of moisture content of food products (UD006)
A homogenised portion of the sample is mixed with sand and heated to 102°C. The moisture loss determined gravimetrically.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
Ref: BS 4401 pt3:1997
LOQ 0.1 g/100g
The method of uncertainty with a coverage factor of 2 (ie 95% confidence level)
Wet pet food is 76.33 g/100g +/- 1.4 g/100g.

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
1	61	1/09	Canned meat meal	Moisture	1.9
1	62	5/09	Canned meat	Moisture	1.4
1	63	8/09	Canned meat	Moisture	-0.1
1	65	12/09	Canned meat	Moisture	-0.8
1	66	1/10	Canned meat meal	Moisture	1.1
1	67	4/10	Canned meat	Moisture	0.6
1	70	7/10	Canned meat	Moisture	1.2
1	71	9/10	Canned meat meal	Moisture	-0.5
1	73	4/11	Canned meat	Moisture	1.3

24	32	1/09	Soya Flour	Moisture	-0.3
24	33	2/09	Breadcrumbs	Moisture	-0.1
24	34	5/09	Wheat flour	Moisture	0.2
24	35	8/09	Porridge oats	Moisture	-2.7
24	36	10/09	Cereal	Moisture	-0.8
25	65	1/09	Butter	Moisture	0.0
25	67	4/09	Canned fish	Moisture	0.1
25	68	4/09	Milk powder	Moisture	0.6
25	69	6/09	Snack food	Moisture	0.4
25	70	5/09	Fish paste	Moisture	1.5
25	71	6/09	Condensed milk	Moisture	-1.4
25	74	8/09	Milk powder	Moisture	0.8
25	77	2/10	Cheese & Pasta meal	Moisture	0.7
25	78	2/10	Canned fish	Moisture	-0.5
25	81	6/10	Fish paste	Moisture	-0.5
25	82	9/10	Condensed milk	Moisture	0.1
25	85	10/10	Chocolate	Moisture	0.1
25	90	4/11	Maize snack food	Moisture	-2.0

Q/002: The determination of the fat content (UD003)
The sample is acid hydrolysed with hydrochloric acid, cooled, filtered and dried. The fat is extract 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
LOQ 0.1 g/100g
The method of uncertainty with a coverage factor of 2 (ie 95% confidence level)
Wet pet food is 7.34 g/100g +/- 0.36 g/100g.
Dry pet food is 7.34 g/100g +/- 0.22 g/100g.

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
1	61	1/09	Canned meat meal	Total fat	-0.8
1	62	5/09	Canned meat	Total fat	-0.8
1	63	8/09	Canned meat	Total fat	0.4
1	67	4/10	Canned meat	Total fat	-1.3
1	70	7/10	Canned meat	Total fat	-1.5
1	71	9/10	Canned meat meal	Total fat	2.5
1	73	4/11	Canned meat	Total fat	0.5
14	77	1/09	Breakfast cereal	Total fat	-2.5
14	81	5/09	Mixed fat spread	Total fat	0.5

14	82	7/09	Infant milk formula	Total fat	0.8
24	35	8/09	Porridge oats	Total fat	0.3
25	65	1/09	Butter	Total fat	-2.1
25	66	2/09	Cheese & pasta meal	Total fat	0.4
25	67	4/09	Canned fish	Total fat	2.4
25	68	4/09	Milk powder	Total fat	0.5
25	69	6/09	Snack food	Total fat	-0.7
25	70	5/09	Fish paste	Total fat	2.5
25	71	6/09	Condensed milk	Total fat	3.0
25	74	8/09	Milk powder	Total fat	2.0
14	93	7/10	Cereal product	Total fat	0.6
14	103	7/11	Cereal product	Total fat	0.5
14	105	8/11	Mixed fat spread	Total fat	0.7

Q/001: The determination of the ash content. (UD007)
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
The method of uncertainty with a coverage factor of 2 (ie 95% confidence level)
Dry pet food is 7.18 g/100g +/- 0.18 g/100g.

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
1	61	1/09	Canned meat meal	Ash	0.0
1	62	5/09	Canned meat	Ash	0.3
1	63	8/09	Canned meat	Ash	0.5
1	67	4/10	Canned meat	Ash	0.2
1	70	7/10	Canned meat	Ash	1.0
1	71	9/10	Canned meat meal	Ash	2.4
1	73	4/11	Canned meat	Ash	0.1
24	32	1/09	Soya Flour	Ash	-0.2
24	33	2/09	Breadcrumbs	Ash	0.4
24	34	5/09	Wheat flour	Ash	1.9
24	36	10/09	Cereal	Ash	-0.9
25	66	2/09	Cheese & pasta meal	Ash	0.5
25	67	4/09	Canned fish	Ash	0.4
25	68	4/09	Milk powder	Ash	0.7
25	69	6/09	Snack food	Ash	-0.3
25	70	5/09	Fish paste	Ash	0.7

25	71	6/09	Condensed milk	Ash	-0.2
25	74	8/09	Milk powder	Ash	1.3

Z/001: The determination of nitrogen and crude protein using Leco instrumentation (UD001)
The sample is analysed by a Leco instrumentation following Dumas procedure: The sample is combusted in an oxygen atmosphere, the gaseous product is cleaned and nitrogen compounds converted to nitrogen which is measured by a thermal conductivity cell. The crude protein is calculated by multiplying by the appropriate conversion factor.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
LOQ 0.1 g/100g
The method of uncertainty with a coverage factor of 2 (ie 95% confidence level)
Wet pet food is 8.09 g/100g +/- 0.4 g/100g.
Feed is 2.72 g/100g +/- 0.06 g/100g.

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
1	61	1/09	Canned meat meal	Nitrogen	1.0
1	62	5/09	Canned meat	Nitrogen	-0.6
1	63	8/09	Canned meat	Nitrogen	0.3
1	67	4/10	Canned meat	Nitrogen	0.4
1	70	7/10	Canned meat	Nitrogen	0.9
1	71	9/10	Canned meat meal	Nitrogen	0.8
1	73	4/11	Canned meat	Nitrogen	0.8
24	32	1/09	Soya Flour	Nitrogen	0.0
24	33	2/09	Breadcrumbs	Nitrogen	-0.2
24	34	5/09	Wheat flour	Nitrogen	0.3
24	35	8/09	Porridge oats	Nitrogen	0.6
24	36	10/09	Cereal	Nitrogen	0.2
25	66	2/09	Cheese & pasta meal	Nitrogen	0.4
25	67	4/09	Canned fish	Nitrogen	0.8
25	68	4/09	Milk powder	Nitrogen	0.7
25	69	6/09	Snack food	Nitrogen	0.1
25	70	5/09	Fish paste	Nitrogen	0.8
25	71	6/09	Condensed milk	Nitrogen	0.4
25	74	8/09	Milk powder	Nitrogen	0.9

H/085: The determination of total dietary fibre by the AOAC method ((H/085)
The sample is weighed and de-fatted if necessary. It is then gelatinised and treated with α-amylase and further digested enzymatically with protease and amyloglucosidase to remove the starch and protein. The dietary fibre is precipitated with IMS, filtered, washed, dried and weighed. Total dietary fibre is then determined gravimetrically and corrected for protein and ash.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680

Ref: AOAC 985.29/45.4.07 (2007)
LOQ 0.5 g/100g
The method of uncertainty with a coverage factor of 2 (ie 95% confidence level)
Weetabix cereal is 10.72 g/100g +/- 1.07 g/100g.

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
24	33	2/09	Breadcrumbs	AOAC fibre	0.3
24	34	5/09	Wheat flour	AOAC fibre	0.3
24	35	8/09	Porridge oats	AOAC fibre	0.6
24	36	10/09	Cereal	AOAC fibre	0.4

CHROM/104: The determination of extractable sugars (UD296)
The sugars are extracted with water, clarified and chromatographically separated on an amine column with an acetonitrile/water mobile phase. The sugars are detected using an evaporative light scattering detector and quantified with reference to calibration standards.
Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
LOQ 0.1 g/100g

The method of uncertainty with a coverage factor of 2 (ie 95% confidence level)

Sugar	Matrix	Level	Uncertainty ±	Unit
Sugar (total)	Cornflakes	26.10	1.59	g/100g
Fructose	Cornflakes	5.22	0.58	g/100g
Glucose	Cornflakes	5.12	0.60	g/100g
Galactose	Cornflakes	4.00	0.58	g/100g
Sucrose	Cornflakes	4.01	0.68	g/100g
Maltose	Cornflakes	4.00	0.78	g/100g
Lactose	Cornflakes	3.75	0.64	g/100g

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
8	33	10/09	Orange juice	Fructose	-1.8
8	33	10/09	Orange juice	Glucose	-4.8
8	33	10/09	Orange juice	Sucrose	-2.6
8	33	10/09	Orange juice	Total sugars	-3.8
20	65	1/09	Chocolate cake mix	Total sugars	-0.4
25	74	8/09	Milk powder	Lactose	-0.4
1	71	9/10	Canned meat meal	Total sugars	-0.4

H/050: The determination of Starch (UD012)
Determination of starch and high molecular weight degradation products of starch in feeding stuffs and milk powders. It is not applicable to feeding stuffs containing beet chips, beet pulp, dried beet tops or leaves, potato pulp, dried yeasts, products rich in inulin (e.g. dried or powdered Jerusalem artichokes) and products containing greaves.
The method consists of two separate determinations. The sample is treated with warm diluted hydrochloric acid, clarified and filtered; the optical rotation of the resulting solution is

determined. In the second determination, the sample is extracted with 40% ethanol and filtered. The filtrate is acidified with hydrochloric acid, clarified and filtered again; the optical rotation of the resulting solution is determined at 20 □□ 2ºC.

Accredited to BS/EN ISO/IEC 17025:2005. UKAS 0680
Ref: The Feeding Stuffs (Sampling and Analysis) Regulations 1982 Method 30a.
LOQ 2 g/100g

The method of uncertainty with a coverage factor of 2 (ie 95% confidence level).
Wheat grain is 68.8 g/100g +/- 1.50 g/100g.

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
10	77	1/09	Poultry ration	Starch	0.4
1	66	1/10	Canned meat meal	Starch	-0.2

CHROM/215: The determination of fatty acids by GC (UD751)
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

The method of uncertainty with a coverage factor of 2 (ie 95% confidence level)

Fatty Acid	Matrix	Level	Uncertainty ±	Unit
FAMES-saturates	Butter	63.6	1.60	%
FAMES-monunsaturates	Butter	26.2	1.00	%
FAMES-polyunsaturates	Butter	3.88	0.26	%
FAMES-trans fatty acids	Butter	2.95	0.20	%
Alpha-linolenic acid (ALA)	Butter	0.524	0.046	%
Eicosapentaenoic acid (EPA)	Butter	0.42	0.040	%
Docosapentaenoic acid (DPA)	Butter	0.12	0.014	%
Docosahexaenoic acid (DHA)	Butter	0.472	0.042	%

FAPAS Results

Series	Round	Date	Sample Type	Determination	Z score
14	77	1/09	Breakfast cereal	Total TFA	0.0
14	77	1/09	Breakfast cereal	Linoleic acid	-0.2
14	78	1/09	Vegetable oil	Saturates	0.5
14	78	1/09	Vegetable oil	Monounsaturates	-0.1
14	78	1/09	Vegetable oil	Polyunsaturates	0.0
14	77	1/09	Breakfast cereal	Total TFA	0.0
14	80	4/09	Fortified oil	Saturates	0.0

14	80	4/09	Fortified oil	Monounsaturates	-0.4
14	80	4/09	Fortified oil	Polyunsaturates	0.5
14	80	4/09	Fortified oil	Total TFA	-0.2
14	80	4/09	Fortified oil	Linoleic acid	-0.1
14	81	5/09	Mixed fat spread	Saturates	0.0
14	81	5/09	Mixed fat spread	Monounsaturates	-0.1
14	81	5/09	Mixed fat spread	Polyunsaturates	-0.2
14	84	8/09	Cod liver oil	Linoleic acid	-1.2
14	84	8/09	Cod liver oil	EPA	-0.4
14	84	8/09	Cod liver oil	DHA	-1.7
14	87	11/09	Mixed fat spread	Saturates	0.4
14	87	11/09	Mixed fat spread	Monounsaturates	-0.1
14	87	11/09	Mixed fat spread	Polyunsaturates	-0.3
14	87	11/09	Mixed fat spread	Total TFA	0
14	87	11/09	Mixed fat spread	Linoleic acid	0
14	87	11/09	Mixed fat spread	EPA	0.7
14	87	11/09	Mixed fat spread	DHA	0.2
14	88	1/10	Vegetable oil	Saturates	0
14	88	1/10	Vegetable oil	Monounsaturates	0
14	88	1/10	Vegetable oil	Polyunsaturates	0.4
14	89	2/10	Olive oil	Saturates	0.5
14	89	2/10	Olive oil	Monounsaturates	-0.1
14	89	2/10	Olive oil	Polyunsaturates	0.3
14	89	2/10	Olive oil	Total TFA	-2.0
14	89	2/10	Olive oil	Linoleic acid	-0.2
14	89	2/10	Olive oil	EPA	-0.3
14	89	2/10	Olive oil	DHA	-1.5
14	89	2/10	Olive oil	Palmitic acid	1.0
14	89	2/10	Olive oil	Stearic acid	-0.3
14	89	2/10	Olive oil	Oleic acid	-1.3
14	89	2/10	Olive oil	DPA	-1.7
14	93	07/10	Cereal product	Saturates	1.1
14	93	07/10	Cereal product	Monounsaturates	0.7
14	93	07/10	Cereal product	Polyunsaturates	-0.2
14	93	07/10	Cereal product	Linoleic acid	-0.2
14	93	07/10	Cereal product	Myristic acid	1.8
14	93	07/10	Cereal product	Palmitic acid	-0.2
14	93	07/10	Cereal product	Stearic acid	-0.2

14	93	07/10	Cereal product	Oleic acid	-0.3
14	93	07/10	Cereal product	Total TFA	0.5
14	95	08/10	Mixed fat spread	Saturates	0.3
14	95	08/10	Mixed fat spread	Monounsaturates	-0.1
14	95	08/10	Mixed fat spread	Polyunsaturates	-0.5
14	95	08/10	Mixed fat spread	Total TFA	0.1
14	96	10/10	Fish oil	EPA	-1.2
14	96	10/10	Fish oil	DHA	-1.5
14	101	05/11	Infant Milk formula	Saturates	0.4
14	101	05/11	Infant Milk formula	Monounsaturates	0.5
14	101	05/11	Infant Milk formula	Polyunsaturates	0.5
14	101	05/11	Infant Milk formula	Total TFA	0.5
14	101	05/11	Infant Milk formula	Linoleic acid	0.4
14	101	05/11	Infant Milk formula	DHA	-0.8
14	103	07/11	Cereal product	Saturates	-1.5
14	103	07/11	Cereal product	Monounsaturates	0.8
14	103	07/11	Cereal product	Polyunsaturates	0.9
14	103	07/11	Cereal product	Total TFA	-2.3
14	103	07/11	Cereal product	Linoleic acid	1.6
14	105	08/11	Mixed fat spread	Saturates	-0.7
14	105	08/11	Mixed fat spread	Monounsaturates	0.3
14	105	08/11	Mixed fat spread	Polyunsaturates	0.3
14	105	08/11	Mixed fat spread	Total TFA	-0.4

A7335 Cholesterol

Method 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 0.7 mg/100 g
Reproducibility 20%
Reference Method ISO 6799: 1992

Ring Test Proficiency Results

Number	Date	Sample Type	Determination	Z score
0249/0325	06/01/11	Cake PTS3	Cholesterol	1.0
0249/326	06/01/11	Salted butter	Cholesterol	0.9
0250/0096	01/02/11	Ham	Cholesterol	-0.7
0250/0095	01/02/11	Chicken	Cholesterol	-0.4
0250/0094	01/02/11	Fish	Cholesterol	-0.8
0253/1384	04/05/11	Chicken	Cholesterol	-2.0
1257/0431	24/10/11	Chicken	Cholesterol	-1.2
1257/0437	24/10/11	Fish	Cholesterol	-1.1
0259/2858	15/11/11	Ham	Cholesterol	0.0

Listed below are details of the analytical methods used in the analysis of inorganics and vitamins and the quality control procedures used with results from reference material measurements during sample analysis.

Inorganics:
Sodium, Potassium, Calcium, Magnesium, Copper, Iron, Manganese, Zinc, Phosphorus, Selenium
Samples are digested in acid under oxidising conditions, using sealed 'bombs' in automated microwave digestors, to prevent losses of volatile metals/inorganics, Metals (and some inorganics) are then determined by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) or by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). These techniques allow the sensitive and accurate (true and precise) determination of metals in foods and allow matrix interferences to be overcome.
In house methods - UKAS accredited.

Sodium

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	24±2	30.9

Potassium

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	24300±300	24040

Calcium

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	15600±200	14910

Magnesium

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	4320±80	4080

Copper

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	3.7±0.4	3.7

Iron

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	218±14	204.3

Manganese

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	98±3	94.1

Zinc

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	17.9±0.4	16.2

Phosphorus

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
SRM 1547	Peach leaves	1370±70	1340

Selenium

Reference Material	Matrix	Expected Level (µg/kg)	Measured Level (µg/kg)
SRM 1547	Peach leaves	120±9	115

Iodide:
Concentrations are determined by high resolution ICP-MS after extraction with tetra methyl ammonium hydroxide.
UKAS accredited.

Reference Material	Matrix	Expected Level (µg/kg)	Measured Level (µg/kg)
NIST 1849	Infant formula	1370±410	1395

Chloride:
Concentrations are determined using a Corning Chloride Analyser after extraction with nitric acid.
In house method FFF/B1-2104 - UKAS accredited.

Sodium Chloride

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
NIST 1849	Infant formula	6280±140	6310

Vitamins – Water Soluble:

The B-vitamin results are expressed as follows:

Thiamin:	thiamin chloride hydrochloride
Riboflavin:	free riboflavin
Niacin:	nicotinic acid
Vitamin B6:	pyridoxine hydrochloride
Pantothenate:	pantothenic acid
Biotin:	d-biotin
B12:	cyanocobalamin
Total folate:	pteroyglutamic acid

Thiamin, Riboflavin & Vitamin B6
Thiamin, riboflavin and Vitamin B6 are determined by HPLC after appropriate and controlled acid and enzymatic hydrolysis. The methods are based on published CEN Standards. The selected method enables determination of total B6 as pyridoxine and is most appropriate to samples of this type where pyridoxine or its phosphate will form the major vitamin B6 component.
UKAS accredited.

Thiamin

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Thiamin (mg/kg)
NIST 1849	Infant formula	15.800±1.95	15	91	16.2
NIST 1849	Infant formula	15.800±1.95	15	91	15.5

Riboflavin

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Riboflavin (mg/kg)
NIST 1849	Infant formula	17.400±1.50	20	95	16.9
NIST 1849	Infant formula	17.400±1.50	20	95	17.4

Vitamin B6

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Vitamin B6 (mg/kg)
NIST 1849	Infant formula	14.2±2.25	10	89	15.680
NIST 1849	Infant formula	14.2±2.25	10	95	15.870

Niacin, Total Folate, Biotin, Pantothenic acid
Determined using microbiological assay (MBA) procedures with detection carried out using VitaFast® MBA test kits.
UKAS accredited.

Niacin

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Niacin (mg/kg)
NIST 1849	Infant formula	97.5±11.7	50	98	99.0
NIST 1849	Infant formula	97.5±11.7	50	98	85.6

Folate

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Folate (mg/kg)
NIST 1849	Infant formula	2.11±0.195	3	95	2.24

Biotin

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Biotin (mg/kg)
NIST 1849	Infant formula	1.920±0.375	1.00	96	1.99
NIST 1849	Infant formula	1.920±0.375	1.00	96	2.01

Pantothenate

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Pantothenate (mg/kg)
NIST 1849	Infant formula	64.8±3.3	50	105	60.2
NIST 1849	Infant formula	64.8±3.3	50	105	68.5

Tryptophan

Determined by HPLC using fluorescence detection after alkaline hydrolysis. Tryptophan contributes to the available Niacin on the basis that Niacin = Tryptophan/60.

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Tryptophan (mg/kg)
NIST 1849	Infant formula	1880±150	1990	121	2160

Vitamin B12

Vitamin B12 is extracted from food by autoclaving in acetate buffer in the presence of cyanide. Vitamin B12 is determined by microbiological assay using *L.Delbrueckii.Lactis.*
UKAS accredited.

Reference Material	Matrix	Expected Level (mg/kg)	Spike Level (mg/kg)	Recovery (%)	Vitamin B12 (mg/kg)
NIST 1849	Infant formula	0.041±0.012	0.010	105	0.035
NIST 1849	Infant formula	0.041±0.012	0.010	105	0.039

Oil Soluble Vitamins:

Vitamins A, D, E and the carotenoids are determined using an in house procedure involving saponification of the sample, solvent extraction and HPLC determination - UKAS accredited methods based on:

- Vitamin A – Retinol: BS EN 12823-1:2000. Foodstuffs-Determination of Vitamin A by High Performance Liquid Chromatography-Part 1: Measurement of Retinol
- Vitamin A – β-Carotene: BS EN 12823-2:2000. Foodstuffs-Determination of Vitamin A by High Performance Liquid Chromatography-Part 2: Measurement of β-Carotene
- Vitamin D: BS EN 12821:2000. Foodstuffs-Determination of Vitamin D by High Performance Liquid Chromatography-Measurement of Cholecalciferol (D3) and Ergocalciferol (D2)
- Vitamin E: BS EN 12822:2000. Foodstuffs-Determination of Vitamin E by High Performance Liquid Chromatography-Measurement of α-, β-, γ- and δ-tocopherols
- Vitamin K: Based on BS EN 14148: Determination of vitamin K1 by HPLC modified to include vitamin K2 isomers.
  After enzymatic removal of fat, Vitamin K1 is extracted into organic solvent and is determined by HPLC with post-column reduction and fluorescence detection.

UKAS accredited.

Vitamin A

Reference Material	Matrix	Expected Level (mg/kg)	Recovery (%)	Measured Level (mg/kg)
NIST 1849	Infant formula	16.4±1.3	95	16.8

Beta-carotene

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
BCR-485	Mixed vegetables	25.6±1.8	21.8

Alpha-carotene

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
BCR-485	Mixed vegetables	9.8±1.05	9.0

Lutein

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
BCR-485	Mixed vegetables	12.5±1.2	11.9

Vitamin D

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
BCR-485	Mixed vegetables	0.251±0.027	0.245
BCR-485	Mixed vegetables	0.251±0.027	0.235
BCR-485	Mixed vegetables	0.251±0.027	0.267

Vitamin E (α-tocopherol)

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
NIST 1849	Infant formula	369±16	340

Vitamin K_1

Reference Material	Matrix	Expected Level (mg/kg)	Measured Level (mg/kg)
NIST 1849	Infant formula	2.20±0.18	2.00
NIST 1849	Infant formula	2.20±0.18	2.10

References

[1] Responsibility for nutrition policy in England transferred from the Food Standards Agency to the Department of Health (DH) on 1 October 2010. Management of the rolling programme of nutrient analysis also transferred to DH.