IAFMM

international association of fish meal manufacturers

Hoval House, Orchard Parade, Mutton Lane, Potters Bar, Hertfordshire, EN6 3AR
Tel: (Potters Bar) 0707 42343/4/5

NUTRIENT ANALYSIS TABLES FOR UK*

TABLE 1

	WHEAT	BARLEY	SOYA 45% PROTEIN	WHITE FISH MEAL[a]	HERRING TYPE FISH MEALS[b]	ANCHOVY TYPE FISH MEALS[c]
			PROXIMATE ANALYSIS (%)			
Moisture %	12.5[3a]	12.5[3b]	10.5[3c]	10[4]	8[4]	10[4]
Crude Protein %	10.9[3a]	11.1[3b]	45.9[3c]	65[4]	72[4]	65[4]
Crude Fat[1] %	1.8[3a]	0.9[3b]	1.4[3c]	5[4]	9[4]	9[4]
Crude Ash %	1.6[3a]	2.5[3b]	5.9[3c]	20[4]	10[4]	16[4]
Crude Fibre %	1.8[3a]	4.1[3b]	5.7[3c]	0[4]	0[4]	0[4]
			ENERGY CONTENT[d]			
POULTRY						
M.E. MJ/Kg[2]	12.5[6]	11.7[6]	9.0[6]	12.1[4,5]	14.0[4,5]	13.2[4,5]
PIGS						
D.E. MJ/Kg[2]	14.7[7a]	13.2[7a]	15.6[7a,7b]	15.6[7a,8]	18.5[7a,8]	16.8[7a,8]
RUMINANTS						
M.E. MJ/Kg[2]	11.6[10]	11.2[9]	11.0[11]	10.3[11]	12.9[11]	12.0[11]

**All data refer to 'as received' basis*

Footnotes to Table 1

a. Produced from offal and whole fish.

b. Generic term including whole fish of species capelin, mackerel, sprat, sand-eels, Norway Pout. Herring type meals may have a protein content in the range of 68% to 74% and a fat content in the range 7% to 12%. For energy values of fish meals of different protein and fat content, see Tables 5 and 6. For fish meals of different protein content, the total content of an amino acid can be assumed to be proportional to the protein content, the amino acid make-up of fish protein being similar; e.g. herring type meal 72% protein:– lysine 5.56%, methionine 2.16%; herring type meal 68% protein:– lysine 5.25%, methionine 2.04%.

c. Fish meals made primarily from whole anchovy fish; fish meals made from whole sardine, horse mackerel are similar in nutrient analysis.

d. The energy values for wheat, barley and soya do not refer to samples with the proximate analysis shown above. See references below for further details.

1. Ether extractives.
2. Can be converted to Kcal/kg (approx) by multiplying by factor 239 (i.e. 4.184J = 1 cal).
3a. Feedstuffs Evaluation Unit, 2nd Report. 1978, p.5. Rowett Research Institute, Dept. Agric. & Fisheries, Scotland.
3b. Feedstuffs Evaluation Unit, 1st Report 1975, p.35. Rowett Research Institute.
3c. From 'Nutrient Requirements of Farm Livestock, No. 4 Composition of British Feedingstuffs' 1976, ARC London.
4. Data mainly given in "Handbook of Nutrition and Food – Fishery By-Products Section" to be published by CRC Press Inc. USA – in press. These figures apply to fish meals with the stated content of crude fat and crude protein. Fish meals with different levels of protein or fat should be assigned different M.E. values using Table 5.
5. See Table 5 and Footnotes.
6. From 'Feeding Values for Poultry' Second Edt. Spelderholt Institute for Poultry Research, Beekbergen, The Netherlands (1979).
7a. Morgan, D.J., Cole, D.J.A., and Lewis, D. (1975). J. Agric. Sci. Camb., 84.7.
7b. The soya bean meal used by Morgan, Cole and Lewis had a proximate analysis of 46.8% crude protein, 1.4% ether extract, 4.2% crude fibre and 88.1% dry-matter, on an 'as received' basis, i.e. it was partly dehulled. For 45% protein soyabean meal the D.E. value should be slightly lower.
8. Calculated using the value given by Morgan *et al.* (see 7) for white fish meal or for herring type meal and adjusting for difference in protein and fat content as in table 6. These figures apply to fish meals with the stated content of crude protein and crude fat. Fish meals with different levels of protein or fat should be assigned different D.E. values using Table 6.

   Digestible energy values on fish meal determined with pigs at the East of Scotland College of Agriculture near Edinburgh (Dr. Colin Whittemore, personal communication) were as follows: white fish meal: 64% crude protein: 4% ether extract, D.E. 15.1 MJ/Kg.

9. Feedingstuffs Evaluation Unit, First Report. Rowett Research Institute 1975. Value refers to M.E. of barley with 12.5% moisture content when fed with grass silage.
10. Feedstuffs Evaluation Unit, Second Report. Rowett Research Institute 1978. Value refers to M.E. of wheat with 12.5% moisture content, when fed with grass silage.
11. Calculated using the equation proposed by workers at the Oskar Kellner Institute at Rostock, DGR. (See MAFF Technical Bulletin No. 33 'Energy Allowances and Feeding Systems for Ruminants' HMSO, (1975).

$$M.E. = 0.152 \times DCP + 0.342 \times DEE + 0.128 \times DCF + 0.159\ DNFE$$

where DCP = Dig. crude protein
DEE = Dig ether extract
DCF = Dig. crude fibre
DNFE = Dig. nitrogen – free extractives

Digestibility coefficients taken from Breirem K. and Homb. T. 'Fôrmidler øg Fôrkonservering' 1970. For anchovy type meal, digestibility coefficients of protein and oil taken to be same as for those of herring type meal, i.e. 0.92, and 0.93 respectively. Those for white fish meal – 0.90 and 0.91 respectively.

INTERNATIONAL ASSOCIATION OF FISH MEAL MANUFACTURERS

NUTRIENT ANALYSIS

TABLE 2

	WHEAT[3]	BARLEY[3]	SOYA 45% PROTEIN[3]	WHITE FISH MEAL[1,4]	HERRING TYPE FISH MEALS[1,4]	ANCHOVY TYPE FISH MEALS[1,4]
	TOTAL AMINO ACIDS+(%)					
Lysine	0.31	0.43	2.88	4.49	5.47	5.07
Methionine	0.18	0.20	0.63	1.69	2.16	1.95
Methionine + Cystine	0.34	0.47	1.31	2.29	2.88	2.60
Tryptophan	0.12	0.15	0.58	0.61	0.83	0.78
Histidine	0.24	0.26	1.12	1.31	1.74	1.59
Leucine	0.73	0.83	3.42	4.21	5.40	4.98
Isoleucine	0.41	0.45	2.20	2.41	3.23	3.06
Arginine	0.51	0.63	3.24	4.14	4.21	3.81
Phenylalanine	0.48	0.62	2.20	2.14	2.82	2.75
Tyrosine	0.33	0.40	1.58	1.69	2.25	2.22
Threonine	0.33	0.42	1.89	2.50	3.07	2.82
Valine	0.50	0.65	2.25	2.91	3.90	3.46
Glycine	0.43	0.48	1.89	6.45	4.30	3.68
Serine	0.54	0.55	2.52	3.09	2.75	2.51
Crude Protein	9.0	11.9	45 0	65.0[2]	72.0[2]	65.0[2]

+ Amino acids in fish meals and soyabean meal are equally available (see Food and Agriculture Organisation Fisheries Report No. 92 entitled 'Available Amino Acid content of Fish Meals' 1970).

Footnotes to Table 2

1. See footnotes a, b and c to Table 1.
2. For fish meals of different protein content, amino acid content can be adjusted assuming that it is similar per unit of protein e.g. methionine content of 72% herring type meal 2.16%; methionine content of 68% herring type meal 2.04%.
3. From 'Feeding Values for Poultry', Second Edition, Spelderholt Institute for Poultry Research, Beekbergen, The Netherlands (1979).
4. Data mainly given in "Handbook of Nutrition and Food – Fishery By-Products Section" to be published by CRC Press Inc. USA. See also IAFMM Technical Bulletin No. 1 'Available Amino Acid Content of Fish Meals'.

INTERNATIONAL ASSOCIATION OF FISH MEAL MANUFACTURERS

NUTRIENT ANALYSIS

TABLE 3

	WHEAT[1]	BARLEY[2]	SOYA 45% PROTEIN[3]	WHITE FISH MEAL[4]	HERRING TYPE[4] FISH MEALS	ANCHOVY TYPE[4] FISH MEALS
				MINERALS		
Calcium %	0.04	0.06	0.37	8.0	2.0	4.0
Phosphorus (total) %	0.29	0.35	0.55	4.8	1.9[9]	2.6
Phosphorus[5] (available) %	0.12	0.14	0.22	4.8	1.9	2.6
Sodium %	0.01	0.02	0.05[6]	1.3[8]	0.70	0.87
Chloride %	0.01[7]	0.01[7]	0.03[7]	2.0[8]	1.03[11]	1.82[11]
Magnesium %	0.12	0.11	0.30	0.15	0.11	0.25
Potassium %	0.5	0.5	1.9[6]	0.9	1.2	0.7
Selenium ppm (mg/kg)	0.2[7]	0.4[7]	0.6[7]	1.5	2.2[10]	1.4
Iron ppm (mg/kg)	33	38	36	300	150	246
Copper ppm (mg/kg)	5	4	41	7	5	11
Zinc ppm (mg/kg)	29	31	67	100	120	111
Manganese ppm (mg/kg)	38	19	36	10	2	10

Footnotes to Table 3

1. From 'Feedstuffs Evaluation Unit, Second Report 1978' Rowett Research Institute Dept. of Agric and Fisheries for Scotland, p.6.
2. From 'Feedstuffs Evaluation Unit, First Report 1975' Rowett Research Institute Dept. of Agric and Fisheries for Scotland, p.36.
3. From 'Nutrient Requirements of Farm Livestock IV. Composition of British Feedstuffs' 1976 ARC London.
4. Data given in 'Handbook of Nutrition and Food – Fisheries By-Products Section' to be published by CRC Press Inc. USA.
5. Availability of phosphorous in wheat – 40%, barley – 40%, soya – 40%, according to 1978 Maryland Feed Composition Data', published by the Department of Poultry Science, University of Maryland.
6. From '1978 Maryland Feed Composition Data' published by Department of Poultry Science, University of Maryland, USA.
7. From 'Poultry Nutrition', 1974 MAFF Bulletin 174.
8. From 'British Fish Meal in Animal Nutrition' A.F.M.M., Hoval House, Mutton Lane, Potters Bar, Herts EN6 3AR.
9. From 'Norsildmel Bulletin' No. 2, May 1971 P.O. Box 1034, Bergen, Norway.
10. From Gabrielsen B.O., and Opstvedt, J. 1980. J. Nutr. 110 No. 6, 1089–1100 (10 samples), Lunde, G. (1973). J. Sci. Fd. Agric., 24 (4)p. 413. (27 samples) and Kifer R.R., and Payne W.I., (1968) Feedstuffs. 40 No. 35 p.32 (12 samples). Figure of 2.2 ppm. Selenium is weighted average for total of 49 samples.
11. Based on salt in figure which was calculated from a chloride determination (see 4 above, Table 2).

INTERNATIONAL ASSOCIATION OF FISH MEAL MANUFACTURERS

NUTRIENT ANALYSIS

TABLE 4

	WHEAT[1]	BARLEY[1]	SOYA 45% PROTEIN[1]	WHITE FISH MEAL[2]	HERRING TYPE[2] FISH MEALS	ANCHOVY TYPE[2] FISH MEALS
			VITAMINS			
Choline ppm (mg/kg)	730	110	2840	4400	4400	4400
Pantothenic Acid ppm (mg/kg)	13.0[3]	6.6[3]	14.5[3]	15.0	30.6	9.3
Riboflavin ppm (mg/kg)	1.1	1.3	4.0	6.5	7.3	6.6
Nicotinic Acid (Niacin) ppm (mg/kg)	58	52	32	50	126	95
Folic Acid ppm (mg/kg)	0.4	0.6	3.6	0.5	0.5	0.16
B12 ppm (mg/kg)	0	0	0	0.07	0.25	0.18
Biotin ppm (mg/kg)	0.10[4a]	0.14[4a]	0.25[4a]	0.08	0.42	0.26
Pyridoxine ppm (mg/kg)	4.0[3]	2.9[3]	8.0[3]	3.3[3]	3.7[3]	3.5[3]
			ESSENTIAL FATTY ACIDS %[5]			
	0.6[3]	0.9[3]	0.4[3]	2.3[6]	4.5[6]	4.5[6]

Footnotes to Table 4

1. From 'Poultry Nutrition' 1974 MAFF. Bull. No. 174.
2. Data given in 'Handbook of Nutrition and Food – Fisheries By-Product Section' to be published by CRC Press Inc. USA.
3. From 'Nutrition of the Chicken' (1976) by Scott M.L., Nesheim, M.C. and Young, R.J.

4a. Biotin – Results of 917 Microbiological Determinations in Feeds, Technical Information, Roche, 318 High Street North, Dunstable, Bedfordshire.

5. Expressed as % linoleic acid or % linoleic acid equivalent (see 3 above).
6. These figures do not correspond to content of linoleic acid but to other fatty acids in stabilised fish meal which will contributed towards requirements for essential fatty acids. See IAFMM Technical Bulletin No. 4. "The Role of Fat in Fish Meal in Pig and Poultry Nutrition'.

METABOLISABLE ENERGY VALUES (MJ/kg) FOR POULTRY OF FISH MEALS WITH DIFFERENT CONTENTS OF PROTEIN AND FAT[2]

TABLE 5

	% CRUDE PROTEIN \ CRUDE FAT %	4	5	6	7	8	9	10	11	12
FISH MEAL[1]	63	11.55	11.83	12.01	12.29	12.56	12.84	13.07	13.35	13.62
	64	11.59	11.87	12.15	12.43	12.70	12.98	13.26	13.53	13.81
	65	11.77	12.06	12.33	12.68	12.89	13.16	13.44	13.67	13.95
	66	11.95	12.23	12.51	12.79	13.03	13.30	13.58	13.85	14.13
	67	12.09	12.37	12.65	12.93	13.21	13.49	13.76	14.04	14.31
	68	12.28	12.56	12.84	13.12	13.39	13.62	13.90	14.18	14.45
HERRING TYPE FISH MEAL	68				12.85	13.12	13.39	13.66	13.93	14.20
	69				13.03	13.30	13.58	13.81	14.08	14.37
	70				13.16	13.44	13.72	13.99	14.27	14.54
	71				13.35	13.62	13.90	14.18	14.41	14.68
	72				13.53	13.76	14.04	14.31	14.59	14.87
	73				13.68	13.95	14.22	14.50	14.77	15.00
	74				13.85	14.12	14.41	14.64	14.91	—

Footnotes to Table 5

1. Includes white-fish meal.
2. Metabolisable energy values, adjusted to zero nitrogen retention (ME_n0), in Table 1 and Table 5 were calculated from the determined ME_n0 with adjustments for the stated crude fat and crude protein contents using the formula:

$$ME_n0_{\text{adjusted}} = ME_n0_{\text{tabulated (assayed)}} + \frac{(F_a - F_t)}{100} \times ME_n0 \text{ for fish fat} + \frac{(P_a - P_t)}{100} \times ME_n0 \text{ for fish protein MJ/kg}$$

Where F_t and P_t are the fat and protein contents of the tabulated samples respectively, and F_a and P_a are the actual fat (ether extractable) and crude protein of the consignment.

For 'Fish Meal' ME_n0 tabulated (assayed) is taken from Cappett S.L., and Soares, J.H., (1972) Poult. Sci. 51, page 2078, and is 12.97 MJ/Kg for 10 fish meals with average protein content of 62.6% and average fat content of 9.8%.

For 'Herring Type Fish Meal' ME_n0 tabulated (assayed) is taken from Opstvedt J. (1976) Feedstuffs, 15.3.76, page 23, and is 13.60 MJ/kg for 40 fish meals with average fat content of 7.7% and average protein content of 71.4%.

Values used for ME_n0 fish fat = 27.00 MJ/kg

and ME_n0 fish protein = 16.52 MJ/kg

taken from Opstvedt J. (1973) Acta Aric. Scand. 23 page 11.

Worked Example

White-fish meal: Fat content (ether extraction) 5%

Protein content 65%

$$ME_n0_{\text{adjusted}} = 12.97 + \frac{(5 - 9.8)}{100} \times 27.00 + \frac{(65 - 62.6)}{100} \times 16.52 \text{ MJ/kg}$$

$$= 12.97 - \frac{4.8}{100} \times 27.00 + \frac{2.4}{100} \times 16.52 \text{ MJ/kg}$$

$$= 12.06 \text{ MJ/kg}$$

DIGESTIBLE ENERGY VALUES (MJ/kg) FOR PIGS OF FISH MEALS WITH DIFFERENT CONTENTS OF PROTEIN AND FAT[2]

TABLE 6

	% CRUDE PROTEIN \ CRUDE FAT %	4	5	6	7	8	9	10	11	12
FISH MEAL[1]	64	15.01	15.33	15.65	15.97	16.29	16.61	16.93	17.25	17.57
	65	15.24	15.56	15.88	16.20	16.52	16.84	17.16	17.48	17.80
	66	15.47	15.79	16.11	16.43	16.75	17.07	17.39	17.71	18.03
	67	15.70	16.02	16.34	16.66	16.98	17.30	17.62	17.94	18.26
	68	15.93	16.25	16.57	16.89	17.21	17.53	17.85	18.17	18.49
HERRING TYPE FISH MEAL	68				16.86	17.18	17.50	17.85	18.17	18.49
	69				17.12	17.44	17.76	18.08	18.40	18.72
	70				17.35	17.67	17.99	18.31	18.63	18.95
	71				17.58	17.90	18.22	18.54	18.86	19.18.
	72				17.81	18.13	18.45	18.77	19.09	19.41
	73				18.04	18.36	18.68	19.00	19.32	19.64
	74				18.27	18.59	18.91	19.23	19.55	–

Footnotes to Table 6

1. Includes white fish meal.
2. Digestible energy values (DE) in Table 1 and Table 6 were calculated from the determined DE with adjustments for the stated crude fat and crude protein contents using the formula:

$$\text{DE adjusted} = \text{DE tabulated (assayed)} + \left[\frac{(F_a - F_t)}{100}\right] \times \text{DE for fish fat} + \left[\frac{(P_a - P_t)}{100}\right] \times \text{DE for fish protein MJ/kg}$$

Where F_t and P_t are the fat and protein contents of the tabulated samples respectively, and F_a and P_a are the actual fat (ether extractable) and crude protein of the consignment.

For 'Fish Meal' and 'Herring-Type Fish Meal' D.E. values tabulated (assayed) are taken from Morgan, D.J., Cole, D.J.A. and Lewis, D. (1975) J. Agric. Sci., Camb., 84, 7. and are:

DE Fish Meal = 14.81 MJ/kg

for fish meals with 5.1% fat and 61.6% protein and:

DE Herring Type Fish Meal = 18.13 MJ/kg

for herring-type fish meal with 7.9% fat and 72.3% protein.

Values used for D.E. fish fat = 32.03 MJ/kg

and D.E. fish protein = 22.96 MJ/kg

These values are based on gross energy values of 38.31 MJ/kg and 24.18 MJ/kg for fish fat and fish protein respectively and digestibilities of fish fat and fish protein in the pig of 83.6% and 95.0% respectively, taken from the publication of work at the University of Norway 'Fôrmidler øg Fôrkonservering (1970) Breiren, K., Homb, T. Ekern, A., Saue, 0., and Opstvedt, J. Forlay Buskap og Avdratt A.S., Gjøvik.

Worked Example

White fish meal: Fat content (ether extraction) 5%

Protein content 65%

$$\text{DE adjusted} = 14.81 + \frac{(5-5.1)}{100} \times 32.03 + \frac{(65-61.6)}{100} \times 22.96$$

$$= 14.81 - 0.032 + 0.781$$

$$= 15.56 \text{ MJ/kg}$$

March 1981

FISH MEAL SCIENTIFIC ADVISORY SERVICE

The International Association of Fish Meal Manufacturers (IAFMM) announces the establishment of a permanent Scientific Advisory Service mainly for Feed Compounders and Concentrate Manufacturers and Agricultural Institutions. The staff of the IAFMM, in conjunction with its Scientific Committee, representing an international group of experts in nutrition, bacteriology, engineering and product development, will provide up-to-date information on any aspect of Fish Meal and its uses. All enquiries should be directed to:

Dr. S. M. Barlow
International Association of Fish Meal Manufacturers,