IAFMM Fish Meal Flyer

international association of fish meal manufacturers

Hoval House, Mutton Lane, Potters Bar, Hertfordshire, EN6 3AR Telex: 94013381 (IAFM G) Tel: (Potters Bar) 0707 42343
Fax: 0707 45489

PROJECT NO: 82.1.5 No: 9 October 1985

THE DIGESTIBLE ENERGY CONTENT OF FISH MEALS FED TO GROWING/FINISHING PIGS

SUMMARY

An extensive series of direct determinations of digestible energy (DE) content of fish meals and soyabean meals fed to pigs were carried out at Nottingham University (UK) and Braunsweig Volkenrode (W Germany). The fish meals (12 samples) represented the main types currently in world trade.

Agreement between the DE values from the two centres was good (see Tables 3a and 3b). Using DE and protein values from the two centres and the fat value determined by solvent extraction (Nottingham), the following regression was obtained:

$$DE = 3.06 + (0.17 \times \%\ \text{crude protein}) + (0.306 \times \%\ \text{fat})\ (r^2 = 0.79).$$

It is recommended that the above regression equation is used to calculate the D.E. of fish meals for pigs, using determined crude protein and fat (light petroleum ether extraction).

The D.E. values tor tne main types of fish meal in world trade, determined using the regression equation above were as listed in Table 4. These are considerably higher (9% to 55% higher) than figures reported in many of the recognized feedstuffs tables. It is recommended that feed formulators should revise their D.E. values in line with values obtained from the present trial.

Introduction

The provision of energy from a pig diet accounts for a major part of the cost. Furthermore, the energy content is a major determinant of the pig's performance. In consequence, there is an increasing requirement for reliable information on the energy value of the diet and dietary ingredients.

Most of the energy values ascribed to fish meals in the past have been arrived at by calaculation using data of uncertain origin. Because of the need for new information on energy values determined in vivo, trials were set up at two centres, Nottingham University in the UK, and Braunsweig Volkenrode (FAL) in West Germany, to measure the digestible energy content of fish meals.

Both centres tested the same 12 commercial fish meals representing the main types in world trade (Table 1). For each type, fish meals with a wide range in protein and fat content were selected. In addition both centres tested different commercial soya bean meal samples obtained locally. Metabolisable energy values of all the proteins were measured by Nottingham University.

Methods

The digestible energy content of the proteins was determined by a substitution method. For each test protein, 25% was substituted for the basal diet of barley (Nottingham) or barley/maize gluten meal (Braunsweig). All diets were supplemented with a mineral/vitamin mix.

At each centre 16 growing male pigs (25kg to 30kg liveweight) were used in a four (diet) x four (pig) Incomplete Latin Square design over five time periods. Following an adaption period of 11 days, urine and faeces were collected in the subsequent five days (Nottingham) or six days (Braunsweig). The former centre catheterised pigs to facilitate urine collection. Both centres used a marker to determine the beginning and end of faeces collection. The diets at both centres were fed according to the UK Agricultural Research Council's Scale (ARC, 1981) less 10% to encourage total consumption of feed.

Analysis of diets and faeces samples for nitrogen was by the Kjeldahl method, for energy by adiabatic bomb calorimeter and for fat in the meals by petroleum ether extraction (Nottingham) or acid

Table 1

ORIGIN AND TYPE OF FISH MEALS

Sample No.	Origin	Type
A	Denmark	Whole fish
B	"	"
C	"	"
D	"	"
E	Ireland	"
F	Chile	"
G	"	"
H	Peru	"
J	U.K.	Offal
K	Norway	Whole fish
L	"	"
M	U.K.	Whole fish/Offal

hydrolysis followed by petroleum ether extraction (Braunsweig). Additionally, urine was collected and its energy content determined from which metabolisable energy values were calculated in the Nottingham trial.

Results and discussion

Analysis of the meals for crude protein and fat content and the determined digestible energy values are shown in Tables 2a (Nottingham) and 2b (Braunsweig). The fish meals ranged in crude protein content from approximately 63% to 71% and crude fat content from approximately 4% to 12%. There were discrepancies in the values from the centres for the same fish meals. Though the fat determination by prior acid hydrolysis (Brau-

Table 2a

COMPOSITION OF FISH MEALS - NOTTINGHAM[1]

Sample No	Protein (%)	Fat (%)[2]
A	69.1	9.6
B	69.6	7.6
C	68.1	12.0
D	68.6	6.4
E	69.6	11.2
F	66.3	9.0
G	67.7	9.1
H	64.5	10.6
J	63.0	4.2
K	68.4	8.7
L	66.8	6.8
M	65.0	8.1

COMPOSITION OF SOYABEAN MEALS - NOTTINGHAM

Sample No	Protein (%)	Fat (%)
1	40.7	2.2
11	44.3	1.5
111	39.2	2.0

[1]as received

[2]by extraction with pet.ether

Table 2b

COMPOSITION OF FISH MEALS - BRAUNSWEIG[1]

Sample No.	Protein (%)	Fat (%)[2]
A	71.2	10.8
B	71.2	7.1
C	69.1	9.2
D	70.1	8.5
E	68.9	11.7
F	66.9	9.8
G	67.1	8.4
H	64.5	9.5
J	63.1	6.0
K	71.1	10.4
L	65.9	7.7
M	64.8	9.2

COMPOSITION OF SOYABEAN MEALS - BRAUNSWEIG

I	43.8	2.5
II	44.6	2.9
III	43.6	2.7
IV	43.3	1.9

[1] as received

[2] by acid hydrolysis followed by pet.ether extraction

nsweig) was expected to give higher fat contents than the direct ether extraction method (Nottingham), this was not apparent in the results.

The determined digestible energy (DE) values for individual fish meals ranged from approximately 14MJ to 19MJ per kg (Tables 3a and 3b). The agreement between the digestible energy results from the two centres was good (see Tables 3a and 3b). Values for eight of the samples agreed to within one MJ. Statistical analysis of the results comparing DE data from the two centres (using a paired t test) showed that the mean difference in the DE values (0.1MJ) was not significant. The standard deviation of the differences was 0.87. It was considered acceptable, therefore, to combine results from the two centres.

Table 3a

DIGESTIBLE AND METABOLISABLE ENERGY VALUES - NOTTINGHAM

Sample No.	Digestible Energy[1] (MJ/kg)	Metabolisable Energy[1] (MJ/kg)
Fish Meal		
A	16.8	14.6
B	17.7	16.3
C	18.8	17.2
D	17.0	15.2
E	18.5	15.9
F	15.8	14.6
G	18.2	16.6
H	18.2	16.7
J	16.1	14.5
K	18.3	16.6
L	15.4	13.4
M	16.6	15.3
Soyabean Meal		
I	14.6	14.3
II	16.1	15.9
III	16.0	15.0
Standard error	1.69	1.92

[1] as received

Table 3b

DIGESTIBLE ENERGY VALUES - BRAUNSWEIG

Sample No.	Digestible Energy[1] (MJ/kg)	Standard Error
A	17.7	0.96
B	18.0	0.43
C	18.8	0.62
D	16.7	1.20
E	17.7	0.76
F	16.3	0.74
G	17.3	0.87
H	17.1	1.18
J	14.4	0.72
K	17.7	0.86
L	16.8	1.68
M	16.6	0.90
Soyabean Meal		
I	15.3	0.57
II	12.9	0.58
III	13.1	0.47
IV	14.3	0.97

([1] as received)

Generally the DE values reflected the protein and fat (solvent extracted) contents of fish meal. The relationships between them was found to be as follows:

= 3.06 + % crude protein x 0.17 + % fat x 0.306.

$r^2 = 0.79$ ($P<0.001$)

using the average DE and protein figures from both centres and fat (solvent extracted) figures from Nottingham.

It is recommended that the above regression equation is used to calculate the D.E. of fish meals for pigs, using determined crude protein and fat (light petroleum ether extraction).

The D.E. values for the following main types of fish meal in world trade, determined using the regression equation above are as listed in Table 4.

Metabolisable energy values determined by Nottingham are also given in Table 3a.

The results show that the lower protein Scandinavian type fish meals and S. American fish meals have similar digestible energy values, whereas meals produced from fish offal tend to be somewhat lower in digestible energy value, probably due to the lower fat content. These DE figures from the two centres are similar to those obtained by Morgan, Cole & Lewis (1975) (herring type fish meal 18.3MJ/kg; white fish offal meal 14.8MJ/kg).

More recently, Morgan, Whittemore & Cockburn at Edinburgh University determined digestible energy of fish meal and soyabean meal fed to pigs and obtained values of 17.4 and 15.0MJ/kg respectively. All these values refer to samples as received.

The digestible energy values for fish meals reported here appear to be considerably higher than those currently used in practice. For example, the Ministry's Agricultural Development and Advisory Service in the UK is currently using a value of

Table 4

DE VALUES FOR MAIN TYPES OF FISH MEAL IN WORLD TRADE

Type of Fish Meal	Crude Protein %	Fat % (Solvent extracted)	Digestible Energy
South American	65	9	16.9
Scandinavian	72	9	18.1
Offal	65	5	15.6

14.7MJ/kg digestible energy for a fish meal with 63% protein and 3.6% oil, presumably a fish meal produced from white fish offal (see UK Ministry of Agriculture, Fisheries and Food, Nutritional Chemistry Pig Feed Data sheet no: NC/PG 126). The Company BP Nutrition in their publication "In facts" gives digestible energy values of 12.9MJ/kg for S. American or Scandinavian meal and 12.2 MJ/kg for white fish meal!

In some countries some feed formulators use the metabolisable energy system (ME) for assessing the energy contribution of ingredients in pig diets, e.g. W Germany and the USA. In both these countries South American fish meals are used.

In Germany, this type of meal would be the major component in a blend with 64% protein. The Deutschen Landwirtschafts--Gesellschaft (DLG) Futtermittel Kontroll-stelle in their publication "Untersuchungsbefunde (1985)" give the ME value of a 64% protein fish meal of 14.7MJ/kg. This is lower than the value found by Nottingham University for South American fish meal (16.0MJ/kg). The ME value given in the US publication "Feedstuffs - 1985 Reference Issue, July 1985" is much lower than the Nottingham figure (Peruvian Anchovy 65% protein, 10% fat ME 2450 Kcal/kg = 10.3MJ/kg).

Conclusion

Trials on fish meal representing the major types commercially available at the present time have shown that digestible energy values can range from 14.4 to 18.8MJ/kg, depending on the protein and fat content of the fish meals. The values obtained for the main types of fish meal in World Trade (South American 16.9MJ/kg; Scandinavian 18.1MJ/kg; Offal 15.6MJ/kg) agree with values determined earlier at Nottingham University (Morgan *et al* 1975) and at Edinburgh University (Morgan *et al*, 1984). They are considerably higher than those currently being used by many feed formulators. It is recommended that feed formulators should revise their digestible energy values in line with values obtained from the present trials.

References

ARC 1981 UK Agricultural Research Council, CAB 'The Nutrient Requirements of Pigs'

Morgan, etc, D.J., Cole, D and Lewis, D., 1975 J. Agric Sci, (Camb) 84 7 to 71.

Morgan, C.A., Whittemore, C.T. and Cockburn, J.H.S. (1984) Animal Feed Science and Technology 11 to 34.

BP Nutrition 1985 'In Facts - Feed formulation data' BP Nutrition (UK) Ltd., Wincham, Northwich, Cheshire CW9 6BF, U.K.