



ISBN 90-71463-00-0 Published by: Subcommittee Energy of the Working Group nr. 2 Nutrition of the European Federation of Branches of the World's Poultry Science Association Address Secretariat: Ir. W. M. M. A. Janssen Spelderholt Centre for Poultry Research and Information Services 7361 DA Beekbergen, The Netherlands. Tel. 05766-6111 Telex: COVP NL 30757 Printed in the Netherlands, by Grafisch bedrijf Ponsen & Looijen bv, Wageningen This Publication can be ordered by transferring Dfl. 25,- Bank account 4377.59.407 of the Amro Bank, Beekbergen, The Netherlands. If ordered from abroad Dfl. 9,- must be paid per order to cover bank cost.

EUROPEAN TABLE OF ENERGY VALUES FOR POULTRY FEEDSTUFFS

PREFACE

THE EUROPEAN TABLE OF ENERGY VALUES FOR POULTRY FEED-STUFFS has been produced by a sub-committee of the Working Group No 2 (Nutrition) of the European Federation of Branches of the World's Poultry Science Association. It is intended to be a practical document and we hope that it will be widely used.

The publication of this table has to be seen as a first stage. It has been produced by the collaborative effort of many people and now further collaboration is required to bring about improvements through new experimental work, new analyses and also through experience gained from use of the table. Although specific plans cannot be made it is anticipated that updated editions of the table will appear from time to time.

Increased collaboration between groups in different European countries is important for the development of poultry nutritional science. The poultry and animal feed industries in all countries are now very sophisticated and need information of the highest quality to guide nutritional decisions. Feed continues to account for 60 to 70 percent of the total cost of poultry production. The systems - feed ingredients, feed technology and poultry production, that nutritionists seek to describe and control - are complex and the tools of chemistry and animal experimentation are subject to many minor variations in technique and empirical definitions. In these circumstances, collaboration and the pooling of resources can play a significant role in making further progress.

In the early stages of collaboration many differences in methodology, experimental findings, viewpoints and experience are quickly revealed. This table marks the initial resolution of these differences by debate, calculation and compromise. Taking the table as a starting point it is hoped that in the future such differences can, to some extent, be resolved by scientific debate before experimental work is done. The result will be a much more effective and useful development of this topic.

The authors of the table welcome any comments on the table and its further development. Information from groups who can contribute to its improvement by joining in the collaborative programme will be particularly welcome. Please contact Ir. W M. M. A. Jansen, Spelderholt, Centre for Poultry Research and Information Services, Spelderholt 9, 7361 DA Beekbergen, The Netherlands (Tel. 05766-6111; Telex COVP NL 30757).

INTRODUCTION

1. This European Table of Energy Values for Poultry Feedstuffs is designed for feed formulation in European and other countries of the world. The English text and tables are supplemented by an index in the following languages: Czechoslovak, Danish, Dutch, French, German, Hebrew, Hungarian, Italian, Norwegian, Polish, Portuguese, Russian, Spanish, Swedish and Turkish.

2. The table contains information of four types:

- a) a mean AMEn value for each product.
- b) the chemical composition of a sample which corresponds to this mean AMEn value.
- c) calculation factors for adjusting the AMEn value of samples with different compositions.
- d) average digestibility coefficients for crude protein, crude fat and NFE

The following abbreviations are used:

ME - metabolisable energy (general term).

AMEn - apparent metabolisable energy corrected to zero N-retention.

dm - dry matter.

ash - ash.

cpr - crude protein (N X 6.25).

cfat - crude fat.

cfib - crude fibre.

NFE - nitrogen free extractives (dm - cpr - cfat - cfib - ash).

stc - starch.

sug - sugar.

3. In agreement with the widely accepted convention in most countries APPARENT METABOLISABLE ENERGY VALUES CORRECTED TO ZERO NITROGEN RETENTION, AMEn, are used. The MJ is used as the basic unit, except for mean AMEn values which are given both as MJ/kg and kcal/kg. The following conversion factors are used:

$$1 \text{ MJ} = 1000\text{kJ} = 1,000,000\text{J} = 239,000\text{cal} = 239.0\text{kcal}$$

$$1 \text{ kcal} = 4184 \text{ J} = 4.184\text{kJ} = 0.004184\text{MJ}$$

All composition data and AMEn values are on a dry-matter basis. Digestibility coefficients are also APPARENT, i.e. uncorrected for endogenous losses.

4. A single ME scale has some inevitable limitations for feed formulation and these should be noted.

- a) The AMEn values are based on work with adult birds, mainly cockerels. It is known that ME values for young birds, especially for the fat component of feeds, may be lower. However knowledge in this field is not complete enough to compose a separate table for young birds at this time.
- b) For some feedstuffs AMEn values may not be additive across all levels of use. For molasses, milk products and torula yeast the values are applicable up to a maximum of 50 g/kg; at higher levels the ME is probably lower.
- c) ME values for fats are not additive and this presents problems both in experiments and in feed formulation. The topic of ascribing ME values to fats is not discussed here and typical values only are given in the tables. This important subject requires further development.

5. It is not possible to define exactly the methods used either for the chemical analysis or for ME determinations. The data reflect current European practice in a general sense; crude fat is determined by petroleum or diethyl ether extraction without prior acid hydrolysis; starch and sugar are determined in most cases by enzymic methods.

Because of current interest in the prediction of ME values for both feedstuffs and compound feeds, values for starch and sugar are included. In the table only the calculation factors for barley and barley products include starch. As starch and sugar analyses become more common there will be an opportunity for developing improved calculation factors for many feedstuffs. Because of its widespread use crude fibre is frequently used as a calculation factor although it is recognised that a change to neutral detergent fibre or the direct determination of cell walls would probably improve the efficiency of the equations.

6. In the table feedstuffs have been classified in accordance with common practice. It is recognised that such practice differs to some extent between countries and between different sections of the feed industry. Where the classification used here is found to be inappropriate then the calculation factors can be used to determine the AMEn values for materials of different chemical compositions. In addition the International Feed Numbers are given according to the system proposed by the International Network of Feed Information Centres (INFIC Nos.)

7. For some chemical feedstuffs, ORGANIC ACIDS AND ALCOHOL, ME values cannot easily be determined experimentally. An estimation of ME for these materials can be based on their ATP-forming capacity. The ME value is then calculated by comparing this ATP-capacity with that of a standard product for which both the ATP-capacity and ME values are known. For example; the ATP-forming capacity of starch is 0.2346 mol/g and of alcohol 0.3696 mol/g or 1.58 relative to starch. The AMEn of starch is 17.15 MJ/kg. Thus the AMEn of alcohol can be calculated as $(1.58 \times 17.15 =) 27.10$ MJ/kg.

CHEMICAL COMPOSITION OF FEEDSTUFFS

8. In many European countries tables of feedstuff composition are used. The proximate analysis data in these tables already show some large differences and it was considered undesirable to produce a further table and one specifically for poultry. For this reason the system of calculation for ME values is included in the present table so that the assumptions made about the composition of feedstuffs are of less importance. Furthermore, data are given on a dry matter basis to remove another source of variation. The composition data given here are typical for each class of feedstuff. They were drawn up initially by Mr Jager of Dokumentationsstelle der Universitat Hohenheim, Stuttgart and, after a few modifications, were accepted as suitable. The data are expressed as g per kg dry matter and rounded to the nearest 5 g/kg. Starch and sugar data were derived largely from published literature and have not been rounded.

DIGESTIBILITY COEFFICIENTS

9. In poultry the information on nutrient digestibility is much less reliable than on ME values. For protein in particular the combined excretion of faeces and urine makes experimental methods problematic and the derived figures for NFE are correspondingly affected. In spite of these difficulties the inclusion of digestibility data was considered to be important as they also provided a method of deriving calculation factors for these feedstuffs where regression data were not available.

Initial values were taken from a literature survey made by the Dokumentationsstelle der Universitat Hohenheim. These were then compared with experimental results collected in recent years in The Netherlands and in Denmark and corrections were made. Minor final adjustments were made to the digestibility coefficients to ensure that, for samples with the average compositions given in the table, the AMEn of each feedstuff was the same when calculated by the regression equations and by the digestibility coefficients, as described below. For feedstuffs whose composition deviates from the mean the two methods of calculation may give different results.

It can also be noted that the term (starch + sugar)/NFE might provide a reliable estimate of the digestibility of NFE.

10. For the calculation of AMEn from digestible nutrients the following coefficients were used:

Digestible fat	38.83 kJ or 9.28 kcal per g
Digestible crude protein	18.03 kJ or 4.31 kcal per g
Digestible-NFE	17.32 kJ or 4.14 kcal per g

In all cases crude fibre was assumed to be undigestible.

These factors were derived as the averages from several experiments in which regression lines relating determined AMEn values to determined digestibility values have been calculated. Only small differences are found between experiments of this sort.

METABOLISABLE ENERGY VALUES

11. Many experimental results from Belgium, Denmark, France, Germany, The Netherlands and the United Kingdom were used for defining AMEn values and in the calculation of regression equations. When no direct information was available from research in these countries, reliable, original literature data were used. In some cases the information available was fragmentary and best estimates had to be made. The availability of more recent experimental data is indicated by the use of regression equations for making calculations.

DETERMINATION OF CALCULATION FACTORS

12. Three methods were used to determine calculation factors for ME based on the proximate analysis (starch was considered as a variable for barley and barley products only). The use of the three methods; regression lines, equation lines and digestibility coefficients, reflected the availability of experimental data.

REGRESSION LINES

13. Multiple regression analyses were carried out on combined experimental data from three laboratories in France, Scotland and The Netherlands. The analyses were done by Mr P. J. W. van Schagen at the Spelderholt Centre. In preliminary calculations outlying data points were removed if they deviated from the regression line by more than twice the standard error. When significantly different ($p < 0.05$) regression lines were found for different countries a choice of results from one country was made after examination and discussion of the data.

Most of the analyses were based on organic (ash-free) dry matter and then ash was re-introduced as a diluting factor. In this way the factors from dry matter and ash are made equal but of opposite sign. Exceptions are found for meat meals, meat and bone meals and fish meals. In these cases it was felt that ash might be an effective predictor of quality and the analyses were done on a dry-matter basis.

In the tables the column headed "line code" indicates the use of regression lines as follows. Note that an alternative line for sorghum, using tannin as the predictor, is also available, as shown in the footnote*.

Line code	Product*	Data** origin	No. obs	Calculation factors						RSD	
				dm	ash	cpr	cfat	cfib	stc	***	
R1	Barley 6-row	FR	12	9.258	-9.258				6.810	20	1
R2	Barley 2-row	FR	18	9.258	-9.258				7.516	20	1
R3	Oats	NL	6	12.98	-12.98		48.82	-25.50		12	6
R4	Barley prods	NL	8	13.74	-13.74			-35.58	2.913	11	6
R5	Maize prods	NL+U K	34	17.72	-17.72	-9.931	11.73	-69.34		45	8
R6	Rice	NL	10	19.54	-19.54	-29.10	17.97	-34.29		34	6
R7	Wheat prods	NL	10	16.78	-16.78			-69.20		21	8
R8	Tapioca prods	NL+U K	15	16.38	-16.38			-34.64		19	8
R9	Distillery by-prods	UK	26	16.38	-16.38	-4.066		-26.70		90	1
R10	Sunflow er prods	FR+N L+ UK	19	2.626	-2.626	10.62	26.20			35	5
R11	Meat and Bone mea	FR	10	14.20	-19.15		25.10			58	3
R12	Fish meal	UK	27	15.01	-14.26					55	3
							17.61				

* For Sorghum a regression line from FR-data is possible:

AMEn = 16.13g dm – 165.1g tannin (no.obs.=12 RSD = 199kJ/kg)

** Country of origin of data; FR = France, NL = Netherlands, UK = United Kingdom

*** Residual standard deviation of the lines (kJ/kg)

EQUATION LINES

14. When sufficient data were not available for regression analysis, or when regression analysis was inconclusive, the data for a given product class were divided into three extreme groups with respect to ME value, fat and fibre content. Three equations were formed from the mean values for these variables and solution of these equations gave the calculation factors for dry matter, crude fibre and fat.

In the tables the column headed "line code" indicates the use of these equations as follows:

Line code	Product	Data origin	Calculation factors		
			dm	cfat	cfib
	Groundnu prods	NL	12.42	25.50	-25.47
	Cottonseed prods	NL	8.898	19.72	-12.91
	Sunflower prods with hulls	NL	11.17	32.30	-21.43

DIGESTIBILITY COEFFICIENTS

15. When no data were available for statistical analysis, or when the variability in ME was too small, calculation factors were derived for the average digestibility coefficients and the data given above for the ME yields of digestible nutrients. In the table these products are identified by the line code D. The exception was molasses for which the calculation is based on sugar content.

USING THE CALCULATION FACTORS

16. **EXAMPLE 1** - Calculation of the AMEn of a batch of wheat middlings.

The regression line (R7) is

$$\text{AMEn} = 16.78 \text{ dm} - 16.78 \text{ ash} - 69.20 \text{ cfib}$$

Note that the equations have been written in this form to avoid too many figures appearing in the tables. The units for the coefficients are kJ/g and for AMEn, kJ/kg when ash and crude fibre are expressed as g/kg.

The proximate analysis of a batch of wheat middlings is:

	<u>Dry matter basis</u>	<u>"As-is" basis</u>
dm(g/kg)	1000	850
ash (g/kg)	60	51
cfib(g/kg)	96	81.6
AMEn = 1000 X 16.78 = 16780	850 X 16.78 = 14263	
+ 60 X -16.78 = 1006.8	+51 X -16.78 = -855.8	
+ 96 X -69.20 = <u>-6643.2</u>	+81.6 X -69.20 = <u>-5646.7</u>	
AMEn = 9130.0 kJ/kg	7760.5 kJ/kg	
9.13 MJ/kg	7.76 MJ/kg	

17. **EXAMPLE 2** - Calculation of the AMEn of a batch of maize.

There is no regression line so the calculation factors are based on the digestibility coefficients:

digestibility		kJ/g dig. nutrient		calculation factor
0.84	X	18.03	=	15.15 kJ/g cpr
0.92	X	38.83	=	35.72 kJ/g cfat
0.90	X	17.32	=	15.59 kJ/g NFE

Crude fibre is considered to be indigestible.

The proximate analysis of a batch of maize is:

	<u>Dry matter basis</u>	<u>"As-is" basis</u>
dm (g/kg)	1000	850
cpr(g/kg)	110	93.5
cfat (g/kg)	56	47.6
NFE(g/kg)	810	688.5

$$\begin{array}{rcl}
 \text{AMEn} = 110 \times 15.15 = 1666.5 & & 93.5 \times 15.15 = 1416.5 \\
 + 56 \times 35.72 = 2000.3 & & 47.6 \times 35.72 = 1700.3 \\
 + 810 \times 15.59 = \underline{12627.9} & & 688.5 \times 15.59 = \underline{10733.7}
 \end{array}$$

$$\begin{array}{rcl}
 \text{AMEn} = & 16294.7 \text{ kJ/kg} & 13850.5 \text{ kJ/kg} \\
 & 16.30 \text{ MJ/kg} & 13.85 \text{ MJ/kg}
 \end{array}$$

Code	INFIC Int. feed number	Product	AMEn/ kg dm	Calculations factors																	Apparent digestibility % of	Line code	Code			
				Chemical composition (g/kg dm)								AMEn kJ/kg=														
				MJ	ash	cpr	cfat	cfib	NFE	stc	sug	dm X	+ash X	+cpr X	+cfat X	+cfib X	+NFE X	+stc X	+sug X	cpr				cfat	NFE	
1000		CEREALS																								
1001	4-00-569	Barley 6 Row	13.00	25	110	20	65	780	582	20	9.258	-9.258					6.81		68	61	83	R1	1001			
	4-11-889	Barley 2 Row	13.55	25	135	25	50	765	600	21	9.258	-9.258					7.516		70	64	85	R2	1002			
1003	4-02-879	Maize	15.85	15	100	45	25	815	696	19			15.15	35.75		15.59			84	92	90	D	1003			
1004	4-03-210	Millet	14.20	45	130	40	90	695	590	9			15.15	29.12		15.94			84	75	92	D	1004			
1005	4-04-444	Sorghum (tannin < 0.4)	15.30	20	120	40	30	790	730	15			12.98	32.23		15.76			72	83	91	D*	1005			
1006	4-04-383	Sorghum (tannin > 1.0)	13.65	20	120	40	30	790	730	15			9.197	22.91		14.72			51	59	85	D*	1006			
1007	4-03-309	Oats	12.30	35	125	55	115	670	447	18	12.98	-12.98			48.82	-25.5			75	86	75	R3	1007			
1008	4-04-047	Rye	12.00	25	115	20	30	810	654	64			10.82	12.42		12.99			60	32	75	D	1008			
1009	4-20-362	Triticale	14.45	20	150	20	20	790	625	55			14.43	26.01		14.9			80	67	86	D	1009			
1010	4-05-211	Wheat	14.75	15	130	25	30	800	711	31			14.61	26.4		15.24			81	68	88	D	1010			
2000		SEEDS OF LEGUMES																								
2001	5-13-219	Beans heat treated (Phaseolus vulgaris)	12.30	40	250	25	50	635	412	59			14.25	23.3		12.82			79	60	74	D	2001			
2002	5-02-407	Horsebeans (Vicia faba)	11.55	40	320	15	80	545	420	39			14.25	25.63		12.14			79	66	70	D	2002			
2004	5-20-293	Lupin, blue sweet (Angustifolia)	8.30	40	355	55	165	385	94	54			16.59	33		1.559			92	85	9	D	2004			
2005	5-08-458	Lupin, yellow sweet (Angustifolia aureus)	9.55	55	450	50	165	280	44	51			16.59	33		1.559			92	85	9	D	2005			
2006	5-08-481	Peas (Pisum sativum)	12.70	40	260	15	70	615	478	65			15.51	31.06		13.34			86	80	77	D	2006			
3000		MILLING PRODUCTS																								
3100		Barley Products																								
3101	4-00-543	Barley groats	14.95	25	125	25	15	810	722	23	13.74	-13.74			-35.58	0	2.913		71	76	90	R4	3101			
3102	4-22-154	Barley, mill byprod.	9.25	50	140	40	130	640	280	73	13.74	-13.74			-35.58	0	2.913		71	76	57	R4	3102			
3103	4-00-548	Barley, pearl byprod.	14.25	25	170	40	25	740	599	23	13.74	-13.74			-35.58	0	2.913		71	76	85	R4	3103			
3200		Oat Products																								
3201	4-25-689	Oat feed meal	14.75	25	150	75	55	695	535	17			14.43	28.34		15.07			80	73	87	D	3201			
3202	4-03-331	Peeled, rolled, oat groats	15.65	25	155	80	25	715	652	17			14.97	28.73		15.42			83	74	89	D	3202			
3300		Maize Products																								
3301	4-08-024	Maize flour	15.95	15	100	15	10	860	727	24	17.72	-17.72	-9.931	11.73	-69.34				83	88	94	R5	3301			
3302	4-25-310	Maize product (cfib < 9)	12.50	25	115	75	65	720	551	43	17.72	-17.72	-9.931	11.73	-69.34				78	87	67	R5	3302			
3303	4-02-841	Maize bran (cfib > 9)	9.35	35	100	75	110	680	306	23	17.72	-17.72	-9.931	11.73	-69.34				74	87	47	R5	3303			
3304	5-25-556	Maize germ expeller	15.50	20	100	75	25	780	445	50	17.72	-17.72	-9.931	11.73	-69.34				49	94	88	R5	3304			
3400		Rice Products																								
3401	4-03-942	Rice polished	16.95	10	80	5	5	900	870	70	19.54	-19.54	-29.1	17.97	-34.29				82	88	99	R6	3401			
3402	4-26-380	Rice polishings (< 3 husks)	14.45	80	150	160	60	550	458	72	19.54	-19.54	-29.1	17.97	-34.29				70	87	75	R6	3402			
3403	4-26-381	Rice polishings (3-10 husks)	12.10	115	150	165	110	460	258	79	19.54	-19.54	-29.1	17.97	-34.29				66	87	60	R6	3403			

* AMEn(kJ/kg)=16.13 x g dm - 165.1 x g tannin (RSD=199 kJ/kg)

Note: dm=dry matter; cpr=crude protein; cfat=crude fat; cfib=crude fibre;

NFE= nitrogen-free extract; stc=starch; sug=sugar

Code	INFIC Int. feed number	Product	AMEn/ kg dm	Chemical composition (g/kg dm)								Calculations factors					AMEn kJ/kg=				Apparent digestibility % of			Line code	Code
				MJ	ash	cpr	cfat	cfib	NFE	stc	sug	dm X	+ash X	+cpr X	+cfat X	+cfib X	+NFE X	+stc X	+sug X	cpr	cfat	NFE			
3500		Wheat Products																							
3501	4-00-466	Bakery byproduct	15.45	30	120	30	10	810	652	122			14.43	31.84		15.76			80	82	91	D	3501		
3503	4-21-997	Wheat feed flour	14.05	40	195	50	30	685	482	69	16.78	-16.78			-69.2			82	87	80	R7	3503			
3505	4-28-219	Wheat feed meal	10.75	50	180	45	75	650	310	76	16.78	-16.78			-69.2			78	76	61	R7	3505			
3507	4-05-205	Wheat middlings	9.95	55	180	50	85	630	272	75	16.78	-16.78			-69.2			77	74	55	R7	3507			
3509	4-22-487	Wheat bran	7.80	60	170	50	115	605	156	64	16.78	-16.78			-69.2			73	60	42	R7	3509			
3510	5-05-218	Wheat germ meal	9.30	50	215	60	60	615	234	144			10.46	24.85		9.007		58	64	52	D	3510			
4000		STARCH INDUSTRY PRODUCTS																							
4010	5-25-555	Maize germ expeller	8.60	25	240	100	125	510	246	127			8.295	26.4		7.795		46	68	45	D	4010			
4001	5-09-318	Maize glutenmeal (65 cpr)	16.85	25	740	45	10	180	142	7			17.13	36.89		13.86		95	95	80	D	4001			
4002	5-20-411	Maize glutenmeal (40 cpr)	12.45	40	420	35	45	460	232	34			15.33	30.67		10.74		85	79	62	D	4002			
4003	5-02-900	Maize glutenfeed (20 cpr)	8.75	50	225	35	90	600	233	23	17.72	-17.72	-9.931	11.73	-69.34			85	58	44	R5	4003			
4005	4-02-889	Maize starch	17.15	5	5			990	982	6						17.32				100	D	4005			
4006	4-25-388	Potato starch, gelat.	17.00	5	5			990	960							17.15				99	D	4006			
4007	5-25-392	Potato protein, dried	16.00	25	830	10		135		6			16.23	34.94		16.11		90	90	93	D	4007			
4008	5-04-389	Sorghum glutenmeal	12.85	30	500	70	35	365	273				14.25	31.06		9.7		79	80	56	D	4008			
4009	5-04-388	Sorghum glutenfeed	10.20	70	305	50	70	505	223	22			13.71	31.06		8.834		76	80	51	D	4009			
5000		SUGAR INDUSTRY PRODUCTS																							
5001	4-30-289	Beet molasse	11.05	110	140			750		660							16.74	34		85	S*	5001			
5002	4-13-251	Cane molasse	10.90	100	40			860		650							16.74	34		73	S	5002			
5003	4-06-176	Sugar	15.65	10				990		960							16.3			100	S	5003			

* Line code letter S for calcylation factor for g sugar

Note: dm=dry matter; cpr=crude protein; cfat=crude fat; cfib=crude fibre;

NFE= nitrogen-free extract; stc=starch; sug=sugar

Code	INFIC Int. feed number	Product	AMEn/ kg dm	Chemical composition (g/kg dm)										Calculations factors					AMEn kJ/kg=					Apparent digestibility % of			Line code	Code
				MJ	ash	cpr	cfat	cfib	NFE	stc	sug	dm	+ash	+cpr	+cfat	+cfib	+NFE	+stc	+sug	cpr	cfat	NFE						
6000		DISTILLERS PRODUCTS																										
6001	5-00-516	Brewersgrains (dried)	10.10	45	250	85	170	450	38	10	16.38	-16.38	-4.066		-26.7					84	67	52	R9	6001				
6002	5-00-520	Distillers solubles (dried, barley)	11.20	75	280	75	105	465		18	16.38	-16.38	-4.066		-26.7					88	70	59	R9	6002				
6003	5-02-844	Distillers solubles (dried, maize)	12.25	100	280	50	50	520	100	37	16.38	-16.38	-4.066		-26.7					89	90	67	R9	6003				
6004	5-00-842	Distillers grains (dried, maize)	10.60	35	260	80	155	470	185	31	16.38	-16.38	-4.066		-26.7					85	67	56	R9	6004				
6005	5-12-185	Dist. grains + solubles (dried, barley)	11.05	60	250	55	125	510	53	17	16.38	-16.38	-4.066		-26.7					88	70	59	R9	6005				
6006	5-02-843	Dist. grains + solubles (dried, maize)	11.30	45	280	75	120	480	105	18	16.38	-16.38	-4.066		-26.7					87	75	57	R9	6006				
6007	5-04-024	Dist. grains + solubles (dried, rye)	11.65	70	320	35	85	490			16.38	-16.38	-4.066		-26.7					88	72	66	R9	6007				
6008	5-00-545	Malt sprouts	11.50	75	300	35	140	450	54	136			15.51	26.01			13.16			86	67	76	D	6008				
6009	5-05-527	Yeast (beer, dried)	12.80	80	500	15	25	380	62	15			13.71	22.13			14.72			76	57	85	D	6009				
6010	5-05-530	Yeast (torula utilis)	11.65	85	495	35	30	355	73	5			14.25	17.08			11.26			79	44	65	D	6010				
7000		SINGLE CELL PROTEIN																										
7001		Pruteen	13.50	15	765	90	5						13.34	27.18			6.929			74	70	40	D	7001				
8000		DRIED ROOTS																										
8001	4-13-553	Tapioca rootmeal	14.85	20	25	5	35	915	792	31	16.38	-16.38			-34.64					28	18	92	R8	8001				
8002	4-09-598	Tapioca rootmeal	13.15	60	25	5	65	845	700	19	16.38	-16.38			-34.64					28	18	89	R8	8002				
8003	4-23-980	Sweet potatoes (dried)	14.45	30	30	10	35	895	750	88			3.607	20.97			15.76			20	54	91	D	8003				
10000		OIL SEEDS																										
10001	5-08-120	Groundnuts decort.	23.90	30	300	490	40	140			12.42				25.5	-25.47				81	94	68	E1	10001				
10002	5-08-109	Rapeseed unheated	20.95	50	215	460	80	195					12.62	38.05			3.811			70	98	22	D	10002				
10004	5-04-597	Soybeans heat treated in meal feed*	15.25	50	410	205	60	275	54	77			15.33	32.62			8.314			85	84	48	D	10004				
10005	5-04-597	Soybeans heat treated in pellet feed*	16.25	50	410	205	60	275	54	77			16.23	36.5			7.622			90	94	44	D	10005				
10006	5-10-101	Sunflower seeds	15.50	35	180	330	255	200	15	70			15.33	37.27			2.079			85	96	12	D	10006				
11000		PRODUCTS OF THE OIL SEED INDUSTRY																										
11100		Cottonseed Products																										
11101	5-28-822	Cottonseed expeller decort.	8.80	50	465	70	115	300	30	47	8.898				19.72	-12.91				61	75	31	E2	11101				
11102	5-24-771	Cottonseed meal solv. extr. decort.	7.70	55	470	15	115	345	33	58	8.898				19.72	-12.91				65	28	34	E2	11102				
11103	5-25-821	Cottonseed expeller semi decort.	8.10	70	395	70	170	295	17	50	8.898				19.72	-12.91				61	75	33	E2	11103				
11104	5-14-634	Cottonseed meal solv. extr. semi decort	6.95	55	420	15	175	335	32	51	8.898				19.72	-12.91				65	28	32	E2	11104				
11105	5-21-716	Cottonseed meal expeller not decort.	7.00	55	280	65	245	355	22	56	8.898				19.72	-12.91				58	85	32	E2	11105				
11200		Groundnut Products																										
11201	5-24-752	Groundnut expeller decort.	12.80	60	540	70	55	275	96	114	12.42				25.5	-25.47				85	83	48	E1	11201				
11202	5-03-650	Groundnut solv. extr. decort.	11.40	60	590	15	55	280	103	122	12.42				25.5	-25.47				85	60	42	E1	11202				
11203	5-24-754	Groundnut expeller semi decort.	11.65	60	500	70	100	270	59	81	12.42				25.5	-25.47				85	83	37	E1	11203				
11204	5-24-750	Groundnut solv. extr. semi decort.	10.00	55	535	15	110	285	69	95	12.42				25.5	-25.47				85	60	29	E1	11204				

* In pellet feed one may expect the maximum feeding value of soybeans
Note: dm=dry matter; cpr=crude protein; cfat=crude fat; cfib=crude fibre;
NFE= nitrogen-free extract; stc=starch; sug=sugar

Code	INFIC Int. feed number	Product	AMEn/ kg dm	Chemical composition (g/kg dm)										Calculations factors					AMEn kJ/kg=			Apparent digestibility			Line code	Code
				MJ	ash	cpr	cfat	cfib	NFE	stc	sug	dm	+ash	+cpr	+cfat	+cfib	+NFE	+stc	+sug	cpr	cfat	NFE				
11300		Maize Germ Products																								
11301	5-07-481	Maize germ*	16.10	60	155	200	35	550	368	41			8.836	36.5		13.51				49	94	78	D	11301		
11304	5-	Maize germ and bran meal expeller	11.10	35	160	95	80	630	395	43	17.72	-17.72	-9.931	11.73	-69.34					54	62	69	R5	11304		
11305	5-02-868	Maize germ meal feed solv. extr.	10.95	35	130	30	75	730	454	51	17.72	-17.72	-9.931	11.73	-69.34					58	50	69	R5	11305		
11306	5-05-552	Maize germ meal solv. extr.	5.75	25	250	25	135	565	254	56	17.72	-17.72	-9.931	11.73	-69.34					40	30	40	R5	11306		
11400		Rapeseed Products																								
11403	5-	Rapeseed meal expeller glue. high	8.55	80	380	95	130	315	37	72			12.44	29.12		3.291				69	75	19	D	11403		
11404	5-	Rapeseed meal expeller double zero	10.25	80	380	95	130	315	37	72			13.71	34.94		5.543				76	90	32	D	11404		
11401	5-03-871	Rapeseed meal solv. extr. glue. high	6.70	60	400	25	135	380	45	87			12.44	19.41		3.291				69	50	19	D	11401		
11402	5-06-146	Rapeseed meal solv. extr. double zero	8.25	60	400	25	135	380	45	87			13.71	27.18		5.543				76	70	32	D	11402		
11500		Rice Products																								
11501	5-03-930	Rice bran solv. extr.	8.00	150	175	25	115	535	269	82	19.54	-19.54	-29.1	17.97	-34.29					69	51	58	R6	11501		
11600		Sesame Products																								
11601	5-14-657	Sesame expeller	10.95	115	460	110	70	245	15	10			15.87	27.18		2.598				88	70	15	D	11601		
11602	5-09-906	Sesame meal solv. extr.	9.40	115	500	15	75	295	19	38			16.23	11.65		3.811				90	30	22	D	11602		
11700		Soybean Products																								
11702	5-12-821	Soybean expeller	12.10	60	525	65	35	315	77	111			15.69	29.51		6.236				87	76	36	D	11702		
11704	5-	Soybean solv. extr. Braz.	10.60	70	540	10	70	310	71	102			15.69	19.41		6.236				87	50	36	D	11704		
11706	5-	Soybean solv. extr. (> 7 cfib)	10.10	60	475	25	95	345	67	97			15.69	19.41		6.236				87	50	36	D	11706		
11708	5-06-273	Soybean solv. extr. (3.5-7 cfib)	10.40	70	510	15	70	335	74	107			15.69	19.41		6.236				87	50	36	D	11708		
11710	5-07-605	Soybean solv. extr. (< 3.5 cfib)	11.05	70	555	15	35	325	75	118			15.69	19.41		6.236				87	50	36	D	11710		

* After storage fat digestibility may be reduced to 75 % and AMEn value to 14.65 MJ/kg

Note: dm=dry matter; cpr=crude protein; cfat=crude fat; cfib=crude fibre;

NFE= nitrogen-free extract; stc=starch; sug=sugar

Code	INFIC Int. feed number	Product	AMEn/ kg dm	Calculations factors																	Apparent digestibility			Line code	Code	
				Chemical composition (g/kg dm)								AMEn kJ/kg=									% of					
				MJ	ash	cpr	cfat	cfib	NFE	stc	sug	dm	+ash	+cpr	+cfat	+cfib	+NFE	+stc	+sug	cpr	cfat	NFE				
												X	X	X	X	X	X	X	X							
11800		Sunflower Products																								
11801	5-25-643	Sunflower expeller with hulls	7.40	55	260	115	350	220	37	63	11.17				32.3	-21.43					85	67	67	E3	11801	
11802	5-25-637	Sunflower expeller decort.	9.25	60	465	70	150	255	19	70	2.626	-2.626	10.62	26.2							85	64	64	R10	11802	
11803	5-30-034	Sunflower solv. extr. decort. (32-40	7.60	60	445	15	170	310	23	85	2.626	-2.626	10.62	26.2							85	47	47	R10	11803	
11804	5-25-639	Sunflower expeller semi decort.	8.40	60	375	75	235	255	22	67	2.626	-2.626	10.62	26.2							85	65	65	R10	11804	
11805	5-25-634	Sunflower solv. extr. semi decort.	7.20	60	385	25	225	305	26	80	2.626	-2.626	10.62	26.2							85	51	51	R10	11805	
12000		PRODUCTS OF ANIMAL ORIGIN																								
12100		Milk Products																								
12101	5-01-175	Skimmilk powder	10.85	85	360	10		545		502				17.13	32.62		7.968				95	84	84	D	12101	
12102	4-01-182	Whey powder	8.55	95	135	10		760		749				16.23	32.62		7.968				90	84	84	D	12102	
12103	4-01-186	Whey powder low in lactose	8.35	240	230	15		515		377				16.23	32.62		7.968				90	84	84	D	12103	
12104	5-01-160	Buttermilk powder	11.50	90	340	45		525		420				17.13	32.62		7.968				95	84	84	D	12104	
12200		Meat Meal																								
12201	5-24-895	Meat meal	11.45	255	635	85		25				14.2	-19.15		25.1						80	87	87	R11	12201	
12205	5-	Meat meal low fat	10.55	250	660	45		45				14.2	-19.15		25.1						80	87	87	R11	12205	
12202	5-06-628	Meat meal high fat	12.90	205	625	105		65				14.2	-19.15		25.1						80	87	87	R11	12202	
12203	5-06-630	Meat meal high fat	13.95	165	685	115		35				14.2	-19.15		25.1						80	87	87	R11	12203	
12204	5-06-628	Meat meal high fat	14.15	200	610	150		40				14.2	-19.15		25.1						80	87	87	R11	12204	
12206	5-24-899	Meat meal tankage	14.05	145	735	105		15				14.2	-19.15		25.1						80	87	87	R11	12206	
12300		Meat- and Bone meal																								
12301	5-16-528	Meat- and bone meal	10.35	345	520	110		25				14.2	-19.15		25.1						75	87	87	R11	12301	
12302	5-09-321	Meat- and bone meal high fat	13.50	325	460	220		-5				14.2	-19.15		25.1						75	87	87	R11	12302	
12400		Fish meal																								
12401	5-24-007	Fish meal (60 cpr, < 3 cfat)	11.35	280	655	20		45				15.01	-14.26		17.61						88	86	86	R12	12401	
12402	5-24-008	Fish meal (60 cpr, 3-7 cfat)	12.50	255	645	65		35				15.01	-14.26		17.61						88	86	86	R12	12402	
12403	5-24-010	Fish meal (65 cpr, < 3 cfat)	11.75	255	710	20		15				15.01	-14.26		17.61						88	86	86	R12	12403	
12404	5-24-011	Fish meal (65 cpr, 3-7 cfat)	13.00	220	690	65		25				15.01	-14.26		17.61						88	86	86	R12	12404	
12405	5-24-012	Fish meal (65 cpr, > 7 cfat)	15.05	165	700	135		0				15.01	-14.26		17.61						88	86	86	R12	12405	
12406	5-24-013	Fish meal (67 cpr, < 3 cfat)	12.35	210	735	20		35				15.01	-14.26		17.61						88	86	86	R12	12406	
12407	5-24-014	Fish meal (67 cpr, 3-7 cfat)	13.45	190	735	65		10				15.01	-14.26		17.61						88	86	86	R12	12407	
12408	5-24-015	Fish meal (67 cpr, > 7 cfat)	14.40	160	735	95		10				15.01	-14.26		17.61						88	86	86	R12	12408	
12409	5-24-015	Fish meal (67 cpr, > 7 cfat)	14.60	165	710	110		15				15.01	-14.26		17.61						88	86	86	R12	12409	

Note: dm=dry matter; cpr=crude protein; cfat=crude fat; cfib=crude fibre;
NFE= nitrogen-free extract; stc=starch; sug=sugar

Code	INFIC Int. feed number	Product	AMEn/ kg dm	Chemical composition (g/kg dm)										Calculations factors						AMEn kJ/kg=			Apparent digestibility			Line code	Code
				MJ	ash	cpr	cfat	cfib	NFE	stc	sug	dm	+ash	+cpr	+cfat	+cfib	+NFE	+stc	+sug	cpr	cfat	NFE					
12500		Herring Meal																									
12501	5-24-034	Herring meal Norwegian	15.70	95	790	115						15.01	-14.26		17.61					88	80		R12	12501			
12502	5-24-034	Herring meal Norwegian	14.95	140	750	110						15.01	-14.26		17.61					88	80		R12	12502			
12503	5-24-034	Herring meal Danish	15.40	110	780	110						15.01	-14.26		17.61					88	80		R12	12503			
12600		Other Products																									
12606	5-00-380	Bloodmeal, spray	13.90	45	945	10									14.43	27.18				80	70		D	12606			
12601	5-00-380	Bloodmeal, drum	12.85	45	945	10									13.34	25.24				74	65		D	12601			
12602	5-03-795	Feathermeal, hydrolized*	13.45	20	865	60		55							13.89	24.07				77	62		D	12602			
12603	5-03-798	Poultry offal meal	11.45	180	715	70	15	20							12.98	31.06				72	80		D	12603			
12604	5-24-876	Poultry offal meal, high fat	15.95	110	645	230	5	10							12.98	33				72	85		D	12604			
13000		DEHYDRATED GREEN FEEDS																									
13100		Grass Meal																									
13101	1-23-228	Grass meal (14-16 cpr)	3.45	150	165	40	225	420	45	122					8.115	12.42				45	32	22	D	13101			
13102	1-23-222	Grass meal (16-18 cpr)	4.80	150	195	40	220	395	46	105					10.64	16.7		5.197		59	43	30	D	13102			
13103	1-23-218	Grass meal (> 18 cpr)	5.75	140	215	40	215	390	50	57					11.9	22.91		5.889		66	59	34	D	13103			
13200		Alfalfa Meal																									
13201	1-28-945	Alfalfa meal (14-16 cpr)	3.25	115	170	30	305	380	36	36					9.377	10.87		3.464		52	28	20	D	13201			
13202	1-22-688	Alfalfa meal (16-18 cpr)	4.60	115	195	30	280	380	32	62					10.82	12.81		5.543		60	33	32	D	13202			
13203	1-22-698	Alfalfa meal (> 18 cpr)	5.70	115	215	35	250	385	57	35					12.08	17.86		6.409		67	46	37	D	13203			
13300		Alfalfa Concentrate																									
13301	5-14-661	Alfalfa concentrate	11.60	105	510	65	10	310	18	26					16.77	13.59		6.929		93	35	40	D	13301			

* High quality product with in vitro digestibility of 80 %

Note: dm=dry matter; cpr=crude protein; cfat=crude fat; cfib=crude fibre;
NFE= nitrogen-free extract; stc=starch; sug=sugar

Code	INFIC Int. feed number	Product	Chem. form.	<u>AMEn/kg dry matter*</u>	
				kcal	MJ
14000		Organic acids and alcohol			
14001		Alcohol	C ₂ H ₆ O	6480	27.10
14002		Malic acid	C ₄ H ₆ O ₅	2340	9.80
14003		Acetic acid	C ₂ H ₄ O ₂	2910	12.20
14004		Butyric acid	C ₄ H ₈ O ₂	5370	22.45
14005		Citric acid	C ₆ H ₈ O ₇	2460	10.30
14006		Fumaric acid	C ₄ H ₄ O ₄	2710	11.35
14007		Lactic acid	C ₃ H ₅ O ₃	3480	14.55
14008		Propionic acid	C ₃ H ₆ O ₂	4260	17.80

* Per kg pure product; calculated on base of ATP-forming capacity

Code	INFIC Int. feed number	Product	Fatty acid (% of Fat, as Methylester)								AMEn/kg dry	
			C	12:0	14:0	16:0	18:0	18:1	18:2	18:3	kcal	MJ
15000		VEGETABLE OILS										
15001	4-09-320	Coconut oil	44	15	8	2	8	3	1	8500	35.55	
15002	4-07-882	Maize oil			10	2	26	58	1	9000	37.65	
15003	4-24-950	Olive oil			13	3	63	16	2	8500	35.55	
15004	4-	Palmkernel fat	51	15	8	2	16	1		8500	35.55	
15005	4-	Palm oil		1	41	5	37	11		8000	33.45	
15006	4-30-294	Rapeseed oil			5	2	51	24	8	8500	35.55	
15007	4-20-526	Safflower oil			7	3	13	75	1	9000	37.65	
15008	4-07-983	Soya oil			11	5	23	53	7	9000	37.65	
16000		ANIMAL FATS										
16001	4-00-375	Blended animal fat 1*		2	21	13	38	9	1	8500	35.55	
16002	4-00-375	Blended animal fat 2**		2	21	15	38	6	1	8000	33.45	
16003	4-09-319	Poultry fat		1	18	5	42	20	1	9000	37.65	
16004	4-95-306	Beef tallow		2	23	17	32	4	1	7000	29.30	
16005	4-04-790	Lard		2	23	13	35	8	1	8500	35.55	

* 9% C18:2

** 6% C 18:2