

CVB Table Booklet Feeding of Poultry 2018

**Feeding standards, feeding advices and
nutritional values of feed ingredients for poultry**



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Preface

The publication 'CVB Table Booklet Feeding of Poultry 2018' is the English translation of the Dutch publication 'CVB Tabellenboek Pluimvee 2018'. In 2017 two CVB documentation reports (CVB documentation reports nr. 60 and 61) were published. In CVB documentation report nr. 60 the amount and amino acid composition of basal endogenous losses at the terminal ileum of broilers were estimated based on a meta-analysis on a large number of published scientific studies. In CVB documentation report nr. 61 a Table is published with standardized ileal digestible amino acid coefficients for a wide range of feedstuffs for poultry. This Table is based on 1) a large dataset of published studies in which amino acid digestibility's for a large number of feedstuffs for poultry were determined and 2) on the in CVB documentation report nr. 60 established amount and amino acid composition of basal endogenous losses at the terminal ileum of broilers. The standardized ileal digestible amino acid coefficient values for a wide range of feedstuffs for poultry are presented in this Table and replace the apparent fecal digestibility amino acid values of feedstuffs for poultry that were shown in the CVB Feed Tables since 1979.

Furthermore, a large meta-analysis has been carried out in which the standardized ileal amino acid requirements for a number of essential amino acids for broilers and for laying hens were estimated. A detailed description on how these standardized ileal digestible amino acid requirements were estimated can be found in CVB documentation reports nr. 62 – 75. The estimated standardized ileal amino acid requirements are published in this edition of 'CVB Table Booklet Feeding of Poultry 2018'.

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1 Energy evaluation for poultry

For many years, the Dutch poultry nutrition sector is accustomed to the use of three energy evaluation systems: the ME_{po} for adult, non-laying hens, ME_{la} for laying hens and ME_{br} for broilers.

The ME for adult non-laying hens (ME_{po}) is based on digestibility studies with adult cocks. The ME for laying hens (ME_{la}) is also based on research with adult cocks, but because of a better utilization of digestible fat by laying hens, the ME from digestible fat is upgraded with 15%.

From 2004, the ME_{br} evaluation of feedstuffs has been based on digestibility trials with broilers according to the standard CVB protocol. In 2011 the ME formula is adjusted, using the digestible nutrient contents, for calculating the ME value of feed ingredients for broilers. For that reason the earlier ME_{slk} in the Dutch version of this publication was replaced by ME_{br}. For more information one is referred to the explanation in the CVB Feed table 2018 (see the CVB website: www.cvbdiervoeding.nl).

ME_{br} is also often used for other types of *growing* poultry (e.g., young turkeys, ducks and rearing hens). The ME_{la} is also often applied for other poultry in lay.

Outside The Netherlands, the ME_{po} is frequently used for growing poultry as well as for laying poultry.

In the CVB publications the ME value is expressed in MJ/kg; for concentrates the ME value is also expressed in kcal/kg.

2 Broilers

2.1 Feed Intake

In 2016 several supermarkets in The Netherlands switched to selling poultry meat from slow growing (< 50 g/day) broilers with a lower number of broilers per square meters (< 20 birds per m²). These slow growing broilers have a higher age at the moment of slaughter and a higher feed conversion rate compared to the regular broilers.

In Table 1 the average slaughter weight, age at slaughter, feed intake and feed conversion are shown for regular and slow growing broilers.

Broilers are mostly given three or four kinds of feeds, according to their age: feed I (0 - ca. 2 weeks), feed II (14 – 30 days) and feed III (more than 30 days). When four feeds are fed a so called Prestarter is used (0 – 8 days) before broiler feed I is given. Broiler feed III has no coccidiostats. According to the law, this feed must be fed from at least one to five days prior to delivery/slaughter.

In The Netherlands, often (more than 2/3 of the broilers farms) at least 15% of the birds is delivered at least five days before the final delivery. In such a system, an average growth cycle of 42 days therefore lasts from about 38 to 45 days of age. Over 70% of broilers is delivered at a final weight of 2100 grams or more.

Table 1. Average production period, slaughter weight, % of loss, average growth and feed conversion ratio for regular broilers and slow growing broilers (Bron: KWIN 2016).

	Regular (2013)	Slow growing
Production period (d)	40	56
Slaughter weight (g)	2265	2400
Mortality loss (%)	3.3	2.5
Growth/bird/day (g)	56	42
Feed conversion ^{a)}	1.64	2.07

^{a)} Expressed is the cumulative feed conversion (kg of feed delivered on the farm/kg broiler weight at delivery to slaughterhouse minus the broiler birth weight).

2.2 Controlled feeding

Some 20 - 25 years ago, the losses among broilers had increased considerably compared to earlier years. These higher losses could be partially prevented by applying a controlled feeding schedule. The chickens were then fed restrictedly, based on a growth schedule. The somewhat lower daily gain caused by this system was abundantly compensated for by an improvement in feed conversion. However, genetic improvement plays a major role also in this area. The modern chicken is more capable to handle a high daily growth rate than chickens in the past. Therefore, the need for feed restriction has diminished.

2.3 Adding whole wheat to the diet

Since the 90's the use of whole wheat in broiler rations has gained interest in The Netherlands, for both economical and nutrition-technical reasons. Whole and/or broken wheat stimulates the development of the gizzard and therefore improves intestinal health. Whole wheat is often offered next to an additional compound feed. From about ten days of age the proportion of whole wheat in the broiler ration is gradually increased, up to a maximum of 40%. It is experimentally determined that the use of whole wheat leads to an increase in the weight of the digestive tract. This results in increased losses at slaughter.

2.4 Protein value

For broilers the standardized ileal digestible (SID) amino acid requirements are presented in Table 2. These requirements are estimated using a meta-analysis approach on published scientific studies on amino acid requirements for *ad libitum* fed broilers. More information on the materials and methods part of this meta-analysis and the results of this meta-analysis can be found in CVB documentation reports nr. 62 to 68 (2018). In this meta-analysis scientific studies published in the period 1990 – 2017 were used.

The SID amino acid requirement for the first limiting amino acid, lysine (shown as a % of the feed) was estimated in relationship to the ME value of the feed and as a function of age of the broilers. The SID amino acid requirements of the remaining amino acids were estimated as a ratio relative to the SID-lysine concentration. The estimated amino acid requirements were further estimated for both maximum body weight gain and minimum feed conversion. In Table 2 these estimated amino acid requirements for maximum weight gain and minimum feed conversion are shown together with the standard deviations of these estimated requirements. These standard deviations show the variation in estimated amino acid requirements and gives an idea of the degree of precision of these requirement estimates. In case (e.g., for economic reasons) a lower content is used for one of the amino acids, the contents of the other amino acids may, in principal, also be lowered. However, the content of SID amino acids (as a proportion of the first limiting amino acid) should at least comply with the proportions as presented in Table 2.

Table 2. Estimated requirements for standardized ileal digestible (SID) amino acids for broilers fed ad libitum (in g/kg of feed) ^{a)}.

	Maximum growth				Minimum feed conversion			
Age (weeks)	1	2	3-4	>4	1	2	3-4	>4
Lysine (g/kg)	12.0	11.0	10.2	9.7	12.3	11.4	10.7	10.3
Glycine + Serine ^{b)}	15.0	15.0			15.0	15.0		
MEbr (MJ/kg)	11.9	12.2	12.3	12.6	11.9	12.2	12.3	12.6
(kcal/kg)	2850	2925	2950	3000	2850	2925	2950	3000
Amino acid (as a ratio to lysine in % and $\pm$ st. dev.)								
Methionine + Cysteine	73 $\pm$ 7.4				74 $\pm$ 8.3			
Methionine ^{c)}	40				41			
Threonine	64 $\pm$ 6.7				62 $\pm$ 7.4			
Tryptophan	15 $\pm$ 1.2				13 $\pm$ 1.7			
Valine	77 $\pm$ 5.0				73 $\pm$ 5.2			
Isoleucine	60 $\pm$ 4.5				63 $\pm$ 7.3			
Arginine	107 $\pm$ 1.8				112 $\pm$ 8.3			
Leucine	110				110			

- a) Applying a feeding schedule where the birds are fed restrictedly - at least during a certain period - may lead to different requirements. The dietary SID amino acid contents are attuned to the dietary energy contents that are presented in Table 2. In case diets with deviating MEbr contents are used it is also necessary to recalculate the required dietary SID-lysine contents as is described in CVB documentation report nr. 62 using formula F.5 for maximum body weight gain and formula F.9 for minimum feed conversion ratio.
- b) Probably, the synthesis capacity of the chick is only insufficient from 0 to 2 weeks of age to fully cover the requirements; therefore, the feed should contain a certain minimal amount of these amino acids in this period.
- c) The methionine requirement is estimated to be 55% of the estimated methionine and cysteine requirement.

2.5 Digestible phosphorus and calcium

Table 3 P and Ca requirements of broilers, expressed as g (fecal) digestible phosphorus (DPpo) and g calcium per kg of feed.

Age	Growth rate (g/period)	Feed intake (g/period)	Advised contents ^{a)}	
			DPpo	Ca ^{b)}
0 – 10 days	195	255	4.0	8.8-9.2
10 – 30 days	1065	1715	3.1	6.8-7.1
30 – 40 days	730	1455	2.8	6.2-6.4
40 – 50 days	840	1850	2.7	5.9-6.2

^{a)} contents in g/kg feed.

^{b)} the optimal Ca / DPpo ratio is 2.2 to 2.3.

In October 1997, the system “Digestible Phosphorus Poultry” has officially been implemented. For the contents of digestible phosphorus (DPpo) in feedstuffs the reader is referred to Table 6.2. The P requirement, expressed in g DPpo/kg of feed, depends on the growing rate of the broilers and their feed intake. Table 3 gives the advised contents of DPpo/kg of feed, and the growth rate and feed intake they apply to. For further information on the standards, one is referred to CVB Documentation report no 20 “Final system Digestible Phosphorus Poultry” (1997) (in Dutch).

3 Laying hens and broiler breeders

3.1 Energy value

When fed *ad libitum*, laying hens regulate their feed intake according to their energy requirement. The requirement is then determined by the body weight (maintenance), the growth rate, the egg production level, and the ambient temperature.

Calculation of the energy requirement proceeds from the amounts of energy needed for:

- maintenance: at 25 °C 435 kJ (or 104 kcal) ME_{la} per kg metabolic body weight ($BW^{0.75}$) and 9.5 kJ (or 2.27 kcal) ME_{la} per kg BW for each °C temperature difference,
- growth: 21.5 kJ (or 5.14 kcal) ME_{la} per gram body weight gain,
- production: 12.1 kJ (or 2.89 kcal) ME_{la} per gram of egg.

In Table 4a (laying hens) a growth rate of 1.5 gram per day is assumed at an ambient temperature of 22 °C. Table 4b (broiler breeders) assumes a growth rate of 4.0 gram per day at an ambient temperature of 20 °C.

With a deviating ME_{la}-value of the feed, the amount of feed required can be easily calculated by multiplying the dietary requirement with 11.8/ME_{la} (for laying hens), resp. 11.5/ME_{la} (for broiler breeders) and dividing by the deviating ME_{la} of the feed. E.g.: a laying hen of 1400 g BW and a laying percentage of 95% (with an egg weight of 55 g) needs 107 g feed/day with a ME_{la} of 11.8 MJ/kg. When the feed contains 12.0 ME_{la}/kg the amount of feed required is $107 \times 11.8 / 12.0 = 105$ g/day. If the ME_{la} values is expressed in kcal/kg the values are resp. 2820/(deviating ME_{la}) and 2750/(deviating ME_{la}).

During the production period, phase feeding is often applied. Three important phases are: before, during and after the maximum egg mass (see Table 8).

Table 4a Dietary requirement for laying hens in g/bird/day (based on a feed with 11.80 MJ or 2820 kcal ME_{la}/kg. ^{a)})

BW (g)	Laying percentage at an egg weight of 55 and 60 g, respectively				
	0%	60%	75%	85%	95%
1400	54	87-94	96-104	101-110	107-117
1500	56	90-96	99-106	104-113	110-120
1600	59	93-99	101-109	107-116	113-122
1700	62	96-102	104-112	110-118	115-125
1800	64	98-104	107-114	112-121	118-128
1900	67	101-107	109-117	115-124	121-130
2000	70	103-110	112-120	118-126	123-133

Table 4b *Dietary requirement for broiler breeders in g/bird/day (based on a feed with 11.50 MJ or 2750 kcal MEIa/kg)*

	Laying percentage at an egg weight of 60 and 70 g, respectively				
BW (g)	0%	50%	65%	75%	85%
3000	106	138-143	147-154	153-161	160-169
3200	111	143-148	152-159	159-166	165-174
3400	116	148-153	157-164	164-171	170-179
3600	121	153-158	162-169	169-176	175-184
3800	126	158-163	167-174	173-181	180-189
4000	131	163-168	172-179	178-186	185-194

3.2 Protein value

For laying hens the standardized ileal digestible (SID) amino acid requirements are presented in Table 5. These requirements are the result of a meta-analysis on amino acid requirement studies in laying hens that are published in scientific literature. More information on the materials and methods of this meta-analysis and the results can be found in CVB documentation reports nr. 69 - 75 (2018). The studies used for estimation of amino acid requirements in the meta-analysis were published in the period 1990 – 2017.

Table 5 *Estimated requirements for standardized ileal digestible (SID) amino acids for laying hens to reach maximum production results (egg production and feed conversion). Requirements are based on a laying hen with an egg production rate of 95% producing an egg with a weight of 60 gram.*

SID Amino acid ^{a)}	mg SID-AA per g egg mass	Dietary content (g/kg) ^{b)}	Ratio to lysine (%)
Lysine	13.9	6.9 – 6.2	100
Methionine	7.6	3.8 – 3.4	55
Methionine + Cysteine	12.3	6.1 – 5.5	88
Threonine	9.7	4.8 – 4.3	70
Tryptophan	3.0	1.5 – 1.3	22
Valine	10.8	5.4 – 4.8	78
Isoleucine ^{c)}	11.1	5.5 – 4.9	80

- a) Only the requirements for the first limiting amino acid requirements are presented.
b) Based on a daily feed intake of, respectively, 115 and 128 gram per laying hen and corresponding with body weights of 1.5 and 2.0 kg.
c) The isoleucine requirement also depends on the dietary leucine content. A minimum SID-isoleucine : SID-leucine ration of 45% is required for optimal performance.

3.3 Digestible phosphorus and calcium

The system “Digestible Phosphorus Poultry”, as valid since October 1997, also applies to laying poultry. The P and Ca requirements (expressed as g DPpo and Ca per kg of feed) given in Table 7 apply under the conditions mentioned in Table 6.

Table 6 Conditions for which the given P and Ca requirements for laying hens in Table 1.7 are applicable.

Age (weeks)	White hens			Brown hens		
	growth per period (g)*	feed intake (g/b/d)**	egg mass (g)	Growth per period (g)*	feed intake (g/b/d)**	egg mass (g)
20-28	280	105	57	290	112	59
28-35	50	110	60	80	115	62
35-55	50	115	64	40	120	65
> 55	40	115	66	40	120	67

* The P content of the carcass is 6 g per kg live weight.

** Intake in gram per bird per day.

Table 7 P- en Ca requirements for laying hens ^{a)}.

Age (weeks)	P requirement (g DPpo/kg feed)	Ca requirement (g gross Ca/kg feed) ^{b)}
20-28	3.2	37
28-35	3.0	38-39
35-55	3.0	41-43
> 55	2.8	42-44

^{a)}: Assuming a dark period of 8 hours, during which the birds do not ingest feed.

^{b)}: The Ca requirement is calculated by applying the factorial method, as indicated by the WPSA (1984). A decreasing Ca utilization during the laying period has been taken into account, from about 50% in young hens to about 40% at the end of the laying period.

3.4 Feed restriction of laying hens

Feed restriction of laying hens should go together with an accurate registration of:

- the amount of feed,
- the body weight,
- the laying percentage,
- the egg weight,
- the room temperature,
- the water consumption.

When feed restriction is applied in the laying period, this should start after the maximum egg mass production has been clearly passed (approximately 45-50 weeks). Good farming practices are of the essence. A rule of thumb often used: for each gram egg mass less, offer one gram of feed less.

For broiler breeders, separate feeding systems for cocks and hens enables restricted feeding. An accurate feed restriction limits the body weight of especially cocks, resulting in better fertilization results.

4 Rearing period

During the rearing period, laying hens and broiler breeders are usually fed according to the body weight curve supplied by the rearing company. This implies that the birds are fed restrictively. For rearing hens of laying breeds, this implies a moderate feed restriction (feeding level between 85 and 95% of *ad libitum* intake). On the other hand, young broiler breeders (female) are much stronger restricted. These birds are offered a feeding level between 25 and 50% of *ad libitum* intake. Lately, feeds that support the well-being of the birds gain special attention. A strong feed restriction in the rearing phase leads to hunger and frustration, which is expressed in deviant behavior. By offering feed with a lower energy content and a lower protein content, the birds will spend more time to consume the same amount of energy and nutrients. The increased feed intake will increase physical satiety and decreases appetite. Spending more time on feed intake will lead to more uniform flocks.

Dutch research on rearing hens of laying breeds has revealed that the growth occurs in growth spurts (short periods of high growth rate), and that the birds should be fed accordingly. In practice, this means no restriction for these hens during the first 6 to 8 weeks of the rearing period, followed by a relatively strong restriction from 8 to 15 weeks (suppression of excessive fat accretion). Some weeks before the start of the laying period, an increasing feeding level should prepare the birds for an optimal egg production. Young broiler breeders should, however, be fed restrictively until the start of the laying period. Excessive feed intake just before onset of lay causes too much useless breeding eggs (twin yolks, wind-eggs, et cetera). For both categories of rearing hens, the feeding schedule to be followed furthermore depends on vaccinations, beak trimming and heat stress.

In the rearing period, often two types of feed, with adjusted nutrient contents, are given subsequently. The first phase is from 0 to approximately 6 weeks, and the second phase follows and runs up to the end of the rearing period. Three-phase-systems are also applied: 0-4 weeks, 4-10 weeks and 11-17 weeks.

5 Composition of compound feeds for poultry

Table 8 gives contents of apparent fecal digestible lysine (afdLYS), methionine + cysteine (afdM+C), calcium (Ca) and digestible phosphorus (DPpo) for different diets, as used in practical poultry feeding in The Netherlands.

Because of the recent introduction of the new amino acid system for poultry based on standardized ileal digestibility it is unknown what dietary SID-LYS and SID-M+C used in practice are. Therefore, in Table 8 the fecal digestible lysine and methionine + cysteine are still published.

Table 8 Average composition of practical compound feeds ^{a)} for poultry, as used in The Netherlands.

			Per kg of feed			
	ME ^{b1) b2)}		afdLYS	afd(M+C)	Ca	DPpo
	(MJ/kg)	(kcal/kg)	(g)	(g)	(g)	(g)
Broilers:						
• Broiler pre-starter, 0-8 days	12.30	2940	12.0	8.5	9-10	4.2-4.4
• Broiler feed I. 0(8)-14 days	12.30	2940	11.0	8.1	8.5-9	4.0-4.2
• Broiler feed II.14-30 days	12.65	3025	10.2	7.5	7-7.5	3.1-3.3
• Broiler feed III. from 30 days	12.75	3045	9.7	7.2	6-6.5	2.8-3.0
• Rearing feed 0 – 6 weeks ^{c)}	11.25	2690	8.6	6.5	8.5	3.8
• Rearing feed 7 – 17 weeks	11.20	2675	6.7	5.1	8.0	3.3
Laying hens ^{d)} :						
• Pre-lay. 17-19 weeks of age ^{e)}	11.65	2785	6.3	5.3	20-22	3.3
• 19-35 weeks of age	11.85	2830	6.6	5.9	36-37	3.2
• 35-55/60 weeks of age	11.75	2810	6.2	5.6	39-41	3.0
• from 55/60 weeks of age	11.65	2785	5.9	5.3	42-43	2.8
Broiler breeders:						
• Broiler breeders feed I 23-35/40 weeks of age	11.50	2750	6.1	5.3	29-31	3.1
• Broiler breeders feed II from 35/40 weeks of age	11.10	2650	5.6	5.0	31-33	2.6

^{a)} These averages are based on an inquiry amongst the Dutch compound feed industry in 2007. In practice, higher as well as lower contents may occur, as well as more phases, and/or other age ranges.

^{b1)} In broiler feeds and rearing feeds, the ME_{br} is given. For the other feeds, ME_{la} is stated. afdLYS = fecal digestible lysine; afdM+C = fecal digestible methionine + cysteine.

- b2) Due to the application of carbohydrate degrading enzymes in practice, the ME values of cereals and their by-products are often increased by approximately 6%, depending on type of cereal and bird category,.
- c) In practice, two- and three-phase rearing feeds occur.
- d) Feeds portfolio and age ranges also depend on management system and lay performance. Sometimes, starter feeds are given until peak production (approximately 28 weeks of age).
- e) A pre-lay feed stimulates the feed intake of young hens and improves uniformity. Pre-lay feeds are given from 17 to 19 weeks of age (<5% lay).

6 Composition of feed ingredients

6.1 General explanation

The contents and values of feed ingredients, presented on product base in the tables in the next paragraphs, are mean values calculated from the data of analyses in the CVB database. The chemical contents and feeding values of compound ingredients are expressed also on product base.

For more information on the analysis methods used, the contents of chemical parameters, the contents of digestible nutrients and the calculation of the feeding values of individual feed ingredients for compound feeds the reader is referred to the CVB Feed Table, edition 2018.

The ME values in this table are expressed in MJ/kg. To express the ME value in kcal/kg the ME values in MJ/kg has to be multiplied by 239.

Unless otherwise stated, in this table 'dry matter' is the total content of dry matter, including soil/sand that may be present in some feedstuffs.

6.2 Ingredients for concentrate of poultry g/kg product; except ME values these are expressed in MJ/kg)														
	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	K	Ca	MEbr	MEpo	MEla	DPpo
Alfalfa meal CP > 180 g/kg	903	115	189	30	233	11	26	2.7	29.3	15.4	2.97	4.70	4.77	2.1
Alfalfa meal CP 160 - 180 g/kg	910	109	168	25	271	11	35	3.1	27.3	16.4	2.84	3.84	3.90	2.3
Alfalfa meal, dehydrated or pellet CP 140 - 160 g/kg	911	102	152	22	292	11	26	2.6	26.0	15.4	2.47	2.94	2.99	1.9
Barley	867	20	100	18	43	528	23	3.1	4.9	0.5	11.12	11.91	11.98	1.2
Barley feed, high grade	884	55	133	45	108	234	50	6.3	8.0	1.7	-	8.27	8.46	1.7
Barley mill by-product	886	64	118	38	138	202	23	4.1	7.7	2.6	-	7.01	7.18	1.1
Biscuits, ground CFATH < 120 g/kg	943	19	83	110	5	445	217	1.5	2.6	0.9	15.75	16.11	16.63	0.6
Biscuits, ground CFATH > 120 g/kg	919	18	81	162	7	407	198	1.4	2.3	0.7	16.52	16.56	17.34	0.6
Bloodmeal, spray dried	919	17	903	5	7	-	-	1.7	2.7	0.5	-	12.85	12.85	1.3
Bread meal	897	29	121	53	11	506	69	1.9	2.5	0.8	13.13	14.18	14.42	0.8
Brewers' yeast, dehydrated	925	65	459	26	22	62	25	10.6	19.5	2.0	-	10.81	10.89	-
Coconut expeller CFAT < 100 g/kg	907	61	204	85	113	11	100	5.5	21.2	0.8	-	7.46	7.90	2.6
Coconut expeller CFAT > 100 g/kg	941	63	210	122	127	9	75	5.4	21.1	1.0	-	8.76	9.40	2.6
Coconut extracted	910	69	227	23	129	20	77	5.7	21.0	1.5	-	5.66	5.77	2.7
Cottonseed expeller, partly with husk, CF 140-210 g/kg	933	60	363	74	170	11	38	10.2	14.4	2.2	-	7.56	7.90	3.0
Cottonseed expeller, with husk CF > 210 g/kg	921	51	307	61	230	11	39	10.3	14.5	2.3	-	6.43	6.71	3.1
Cottonseed expeller, without husk, CF 55 - 140 g/kg	932	63	416	105	129	11	39	11.2	14.7	2.4	-	8.68	9.14	3.4
Cottonseed extracted , without husk CF 70 - 140 g/kg	898	65	437	31	120	20	28	10.7	15.7	2.2	-	7.03	7.14	3.2
Cottonseed extracted, partly without husk CF 140 - 200 g/kg	896	63	364	25	166	20	45	10.2	15.2	2.0	-	6.32	6.41	3.1
Cottonseed without husks, CFIBRE < 100 g/kg	935	44	403	308	28	-	41	7.5	9.4	1.2	-	14.02	15.42	2.2
Fat, from animal origin	994	1	-	993	-	-	-	-	0.2	-	30.59	35.47	40.79	-
Fat/oil Sunflower oil, refined	995	-	-	995	-	-	-	-	-	-	35.53	35.54	40.88	-

6.2 Ingredients for concentrate of poultry g/kg product; except ME values these are expressed in MJ/kg)														
	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	K	Ca	MEbr	MEpo	MEla	DPpo
Fat/oil, Soy oil	995	-	-	995	-	-	-	-	-	-	34.95	37.48	43.10	-
Feather meal, hydrolyzed	938	24	833	93	13	-	-	2.8	1.0	5.0	13.14	13.48	13.81	1.9
Feed beans, heat treated	862	52	229	16	45	326	40	4.6	15.2	1.6	-	10.32	10.38	2.4
Fish meal, treated CP > 680 g/kg	917	132	707	101	-	-	-	21.9	14.0	27.0	14.08	14.15	14.64	16.2
Fish meal, treated CP 455 - 590 g/kg	911	195	563	142	-	-	-	26.4	6.4	40.1	13.74	13.74	14.44	19.6
Fish meal, treated CP 590 - 650 g/kg	929	170	640	114	-	-	-	26.4	8.0	40.9	13.91	13.95	14.51	19.5
Fish meal, treated CP 650 - 680 g/kg	912	158	656	106	-	-	-	25.0	9.4	37.9	13.70	13.75	14.27	18.5
Grass meal CP > 200 g/kg	917	126	208	40	201	13	88	4.1	31.5	5.3	4.72	5.30	5.40	3.1
Grass meal CP 140 - 160 g/kg	928	123	151	32	212	13	106	3.8	27.3	5.3	4.18	3.36	3.44	2.9
Grass meal CP 160 - 200 g/kg	929	121	177	38	211	13	90	4.0	29.1	5.3	4.31	4.50	4.60	3.0
Grass meal CP 45 - 140 g/kg	929	108	122	25	235	13	122	3.2	24.1	5.3	3.98	3.13	3.19	2.4
Horse beans, colored	870	33	251	12	78	329	28	5.4	12.2	1.0	9.81	10.42	10.46	2.4
Horse beans, white flowered	880	35	286	14	80	341	40	5.2	13.4	1.5	10.70	11.23	11.28	2.3
Lentils	873	30	230	13	45	413	48	3.8	9.4	0.8	-	-	-	-
Linseed	917	42	217	349	73	14	23	5.0	7.5	2.7	-	-	-	-
Linseed expeller	916	54	331	109	85	27	42	8.2	11.8	3.5	-	8.05	8.56	2.0
Linseed, extracted	872	55	320	30	96	35	43	8.4	10.9	3.1	-	5.59	5.72	2.1
Lupines CP 250 - 335 g/kg	908	28	314	51	154	12	53	2.9	7.8	2.4	8.18	7.49	7.68	1.4
Lupines CP > 335 g/kg	878	39	362	46	138	21	48	3.5	8.1	2.3	8.93	8.12	8.29	1.7
Maize	867	12	76	36	20	620	13	2.4	3.4	0.1	13.51	13.70	13.87	0.7
Maize bran	873	14	94	34	99	289	17	4.6	-	0.3	6.70	7.50	7.61	1.7
Maize feed flour	875	6	76	12	8	685	10	0.7	1.2	0.2	13.45	14.28	14.33	0.3
Maize feed meal	880	23	91	72	40	455	23	4.0	4.6	1.3	12.11	12.58	12.92	1.5
Maize germ, extracted	878	34	199	26	74	269	3	5.2	4.5	0.5	8.13	8.20	8.29	2.1
Maize germ meal feed expeller	896	44	134	56	59	334	51	8.3	9.0	1.0	9.67	10.43	10.63	3.3
Maize germ meal feed, extracted	875	39	138	24	63	325	10	5.7	7.2	0.9	8.04	9.27	9.35	2.3
Maize gluten meal	895	15	599	56	10	176	1	4.3	1.4	0.3	14.14	15.06	15.33	1.7
Maize gluten feed CP > 230 g/kg	889	62	240	41	74	97	26	9.5	11.2	2.0	6.83	7.82	7.99	3.8

6.2 Ingredients for concentrate of poultry g/kg product; except ME values these are expressed in MJ/kg)														
	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	K	Ca	MEbr	MEpo	MEla	DPpo
Maize gluten feed CP 110 - 200 g/kg	888	57	188	35	73	145	23	9.5	12.4	0.7	6.78	8.29	8.44	3.8
Maize gluten feed CP 200 - 230 g/kg	895	59	203	40	73	122	24	9.6	12.1	1.6	6.71	8.32	8.49	3.8
Maize, heat treated	882	13	84	42	21	614	15	3.0	3.5	0.3	13.57	14.01	14.21	0.9
Maize starch	892	1	6	5	2	851	-	0.4	-	-	14.65	15.21	15.21	0.2
Meat meal CFATh > 100 g/kg	944	217	561	136	20	-	-	31.8	5.1	57.4	12.37	12.66	13.34	19.7
Meat meal CFATh 35 - 100 g/kg	940	234	575	85	23	-	-	34.9	7.0	69.8	10.96	11.00	11.43	21.6
Meat meal, Dutch origin	946	167	581	138	28	-	-	22.8	6.2	46.2	13.00	13.69	14.41	14.2
Meat-and-bone meal, CFATh < 100 g/kg	943	392	455	87	15	-	-	62.5	3.1	130.1	-	8.06	8.37	38.1
Meat-and-bone meal, CFATh > 100 g/kg	938	355	450	134	14	-	-	62.2	3.1	129.3	-	9.89	10.51	37.9
Milk powder, skimmed	951	79	356	10	-	-	489	10.2	16.5	12.6	-	12.57	12.63	8.1
Millet	881	32	111	40	99	497	8	2.8	3.0	0.1	-	12.19	12.36	1.1
Millet, Bulrush	912	25	122	45	20	606	14	3.3	3.5	0.2	-	14.20	14.40	1.2
Molasses, sugar beet	758	80	101	2	-	-	477	0.8	38.0	1.3	-	7.85	7.85	0.4
Molasses, sugarcane SUG > 475 g/kg	724	91	35	-	-	-	485	0.7	27.5	6.8	8.40	7.98	7.98	0.3
Molasses, sugarcane SUG 370 - 475 g/kg	729	111	49	1	1	-	451	0.7	40.5	7.8	7.93	7.42	7.42	0.3
Oats	878	25	102	40	106	380	10	3.2	4.3	0.7	9.94	10.31	10.51	1.6
Oats, peeled	887	19	132	66	16	545	14	4.3	4.0	0.6	14.07	14.61	14.94	2.2
Peanut expeller, without shell CF 30 - 75 g/kg	932	64	476	81	61	62	93	4.8	9.9	2.3	11.55	12.10	12.51	1.8
Peanut expeller, partly with shell CF 75 - 145 g/kg	920	51	423	87	95	61	92	4.7	9.8	2.2	-	11.24	11.69	1.8
Peanut expeller, with shell CF > 145 g/kg	933	41	346	97	157	62	93	4.8	9.9	2.3	-	10.07	10.58	1.8
Peanuts (peanuts) without shell CF < 85 g/kg	932	22	287	490	23	62	30	4.4	5.4	1.0	-	23.48	26.17	1.7
Peanut extracted, partly with shell CF 75 - 145 g/kg	926	56	529	9	116	61	76	6.5	12.7	1.8	-	8.78	8.78	2.5
Peanut extracted, without shell, CF < 30 - 75 g/kg	913	60	456	12	64	60	75	6.4	12.5	1.8	8.59	10.00	10.04	2.4
Peas	866	28	203	10	54	416	44	3.7	9.9	0.9	11.11	11.29	11.32	1.5

6.2 Ingredients for concentrate of poultry g/kg product; except ME values these are expressed in MJ/kg)														
	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	K	Ca	MEbr	MEpo	MEla	DPpo
Potato crisps	962	35	59	300	11	444	28	1.4	11.2	0.3	-	-	-	-
Potato protein, ASH < 10 g/kg	908	6	795	11	7	5	9	1.6	0.2	0.4	13.12	14.22	14.25	1.0
Potato protein, ASH > 10 g/kg	904	20	785	31	8	1	9	2.0	6.6	0.5	13.55	14.17	14.27	1.3
Potato starch, dried	875	45	39	-	3	728	35	1.6	0.4	0.2	-	12.83	12.83	0.9
Rape seed	924	39	198	416	100	15	56	6.3	7.4	4.1	17.21	15.22	16.94	2.1
Rape seed expeller	904	62	316	99	121	7	75	10.2	11.4	6.9	8.39	9.17	9.65	3.4
Rape seed, extracted CP > 370 g/kg	906	84	388	16	115	11	89	10.7	12.6	7.2	6.68	7.36	7.42	3.5
Rape seed, extracted CP 290 - 370 g/kg	889	67	344	32	121	8	83	10.5	12.8	7.8	6.37	7.26	7.38	3.5
Rice bran, extracted	901	108	143	15	113	270	26	16.5	12.3	1.1	-	7.71	7.76	2.6
Rice feed meal ASH < 90 g/kg	897	73	139	147	55	304	41	14.2	9.9	4.1	12.13	12.80	13.55	2.3
Rice feed meal ASH > 90 g/kg	911	124	137	168	55	234	35	17.4	10.0	26.7	9.08	12.52	13.38	2.8
Rice, crude with hulls	886	44	73	19	102	463	13	2.6	3.4	0.4	-	11.17	11.25	0.4
Rice, crude without hulls	885	7	78	8	7	715	9	0.9	0.9	0.1	14.00	14.77	14.80	0.1
Rye	870	16	97	13	21	514	59	3.1	4.6	0.4	-	11.47	11.49	1.2
Sesame seed, expeller	943	132	451	115	62	-	25	9.8	9.4	19.1	10.99	10.81	11.28	2.9
Sesame seed, extracted	893	60	430	16	117	-	63	12.9	10.4	23.0	6.18	8.29	8.32	3.9
Sorghum	872	15	87	28	23	606	8	2.7	3.5	0.3	12.77	13.27	13.41	0.8
Sorghum gluten meal	900	32	430	54	36	246	-	3.0	-	-	-	12.01	12.26	0.9
Soya beans, heat treated	897	49	363	197	58	6	70	5.0	16.7	2.2	13.09	13.89	14.85	2.0
Soybean expeller	888	61	438	81	60	8	82	6.1	21.0	2.7	10.35	10.60	10.98	2.5
Soybean meal, solvent extracted CF 45 - 70 g/kg; CP < 450 g/kg	877	61	426	22	60	9	91	6.6	21.9	3.1	8.42	8.70	8.74	2.8
Soybean meal, solvent extracted CF 45 - 70 g/kg; CP > 450 g/kg	877	61	464	16	55	5	90	6.4	21.9	3.1	8.74	8.88	8.90	2.7
Soybean meal, solvent extracted HiPro CF < 45 g/kg; CP < 480 g/kg	887	64	468	16	38	11	99	6.8	22.2	3.1	9.04	9.21	9.23	2.8
Soybean meal, solvent extracted HiPro CF < 45 g/kg; CP > 480 g/kg	872	65	485	19	37	8	103	6.4	21.8	3.0	9.36	9.32	9.35	2.7

6.2 Ingredients for concentrate of poultry g/kg product; except ME values these are expressed in MJ/kg)														
	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	K	Ca	MEbr	MEpo	MEla	DPpo
Soybean meal, solvent, extracted CF > 70 g/kg	871	63	417	16	76	12	84	5.9	21.8	3.0	8.02	8.16	8.19	2.5
Sugar	1000	-	-	-	-	-	1053	-	-	-	17.32	16.41	16.41	-
Sunflower seed dehulled, CF < 90 g/kg	940	34	212	450	75	4	32	4.4	9.2	2.4	19.48	20.39	22.91	1.4
Sunflower seed expeller with hulls CF > 315 g/kg	913	56	214	103	372	2	26	7.6	12.9	2.9	-	6.28	6.68	2.0
Sunflower seed expeller, dehulled, CF 120 - 200 g/kg	930	63	381	73	163	5	60	7.7	13.1	2.9	8.36	8.22	8.50	2.1
Sunflower seed expeller, partly dehulled, CF 200 - 315 g/kg	924	59	287	100	239	4	47	7.7	13.0	2.9	7.93	7.94	8.31	2.1
Sunflower seed with hulls, CF > 200 g/kg	914	27	140	291	285	4	33	4.3	7.8	2.3	12.58	13.33	14.96	1.4
Sunflower seed, extracted, dehulled CF < 160 g/	892	66	382	17	148	8	53	10.3	14.9	3.5	6.48	6.68	6.73	2.8
Sunflower seed, extracted, partly dehulled CF 160 - 200 g/kg	892	67	352	19	178	8	50	10.3	14.9	3.5	6.03	6.40	6.45	2.8
Sunflower seed, extracted, partly dehulled CF 200 - 240 g/kg	888	64	308	19	224	8	52	10.2	14.8	3.5	5.39	5.94	6.00	2.8
Sunflower seed, extracted, with hulls CF > 240 g/kg	890	59	270	19	274	8	44	10.3	14.8	3.5	4.75	5.20	5.25	2.8
Sweet potatoes, dried	878	38	40	6	27	592	68	1.3	5.8	1.7	11.90	12.24	12.24	1.0
Tapioca, dehydrated STAew 550 - 625 g/kg	883	58	23	5	62	593	9	0.7	6.0	4.1	10.82	11.36	11.36	0.5
Tapioca, dehydrated STAew 625 - 675 g/kg	879	58	23	5	53	620	8	0.7	6.2	2.5	11.24	11.61	11.61	0.5
Tapioca, dehydrated STAew 675 - 725 g/kg	873	51	23	4	48	653	7	0.9	6.6	2.0	11.77	11.79	11.79	0.6
Tapioca starch	880	1	11	2	2	855	-	0.4	-	0.2	14.85	14.82	14.82	0.2
Wheat	858	15	112	14	23	589	27	2.8	3.8	0.4	12.47	12.80	12.84	1.1
Wheat bran	870	48	155	33	106	136	58	9.8	12.3	1.4	5.60	6.49	6.57	2.6
Wheat feed flour CF > 35 g/kg	867	29	155	38	44	325	65	6.6	9.9	0.9	9.86	11.03	11.21	1.8

6.2 Ingredients for concentrate of poultry g/kg product; except ME values these are expressed in MJ/kg)														
	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	K	Ca	MEbr	MEpo	MEla	DPpo
Wheat feed flour, CF < 35 g/kg	866	23	154	35	24	419	46	4.7	5.9	0.6	11.07	12.50	12.66	1.3
Wheat feed meal	869	44	153	34	69	223	68	8.2	12.7	1.0	7.13	9.07	9.20	2.2
Wheat germ feed	866	40	179	46	52	245	65	9.1	10.3	0.9	7.95	10.27	10.47	2.5
Wheat middling's	874	41	154	35	85	184	63	8.8	13.3	0.9	6.52	8.10	8.23	2.4
Whey powder	976	80	130	9	-	-	698	6.2	23.1	5.4	-	11.59	11.63	5.0
Whey powder, low lactose, ASH < 210 g/kg	956	177	252	53	-	-	467	14.7	45.3	17.6	-	11.58	11.84	11.8
Whey powder, low lactose, ASH > 210 g/kg	962	230	217	41	-	-	444	19.6	48.7	33.8	-	10.60	10.80	15.7

- In general, CFAT is analyzed without acid hydrolysis. STA (starch) is analyzed with amyloglucosidase.
- The value for MEbr is calculated with CFAT content analyzed after acid hydrolysis (= CFATh). This means that MEbr is often calculated with a different (slightly higher) crude fat content as is shown in the column 'CFAT'.
- The processing of animal meal, greaves meal and meat-and-bone meal in poultry feed is currently forbidden within the EU.
- In The Netherlands processing of feather meal in poultry feed is currently forbidden.
- The MEbr, MEpo and MEla of vegetable fat/oil depend on the fatty acid composition

6.3 Minerals

It is recommended to express the mineral contents as elements and not as oxides. To recalculate mineral contents expressed as oxides into elements the next factors can be used:

From:	To	Multiply with:
K ₂ O	K	0.830
Na ₂ O	Na	0.742
NaCl	Na	0.393
CaO	Ca	0.715
MgO	Mg	0.603
P ₂ O ₅	P	0.437
SO ₃	S	0.400
SO ₄	S	0.334

7 Relevant CVB publications

Many data in the Table booklet Feeding of Poultry concerning the feeding standards and feeding advices are derived from CVB documentation reports. Below an overview is given of the relevant CVB documentation reports (in Dutch).

- nr. 20: Definitief systeem Opneembaar Fosfor Pluimvee (1997)
- nr. 60: Amount and amino acid composition of basal endogenous protein losses at the terminal ileum of broilers (2017)
- nr. 61: Table 'Standardized ileal digestibility of amino acids in feedstuffs for poultry' (2017)
- nr. 62: Standardized ileal digestible lysine requirement for broilers (2018)
- nr. 63: Standardized ileal digestible methionine and cysteine requirement for broilers (2018)
- nr. 64: Standardized ileal digestible threonine requirement for broilers (2018)
- nr. 65: Standardized ileal digestible tryptophan requirement for broilers (2018)
- nr. 66: Standardized ileal digestible valine requirement for broilers (2018)
- nr. 67: Standardized ileal digestible isoleucine requirement for broilers (2018)
- nr. 68: Standardized ileal digestible arginine requirement for broilers (2018)
- nr. 69: Standardized ileal digestible lysine requirement for laying hens (2018)
- nr. 70: Standardized ileal digestible methionine and cysteine requirement for laying hens (2018)
- nr. 71: Standardized ileal digestible threonine requirement for laying hens (2018)
- nr. 72: Standardized ileal digestible tryptophan requirement for laying hens (2018)
- nr. 73: Standardized ileal digestible valine requirement for laying hens (2018)
- nr. 74: Standardized ileal digestible isoleucine requirement for laying hens (2018)
- nr. 75: Minimum dietary SID-ILE : SID-LEU and SID-VAL : SID-LEU ratios for laying hens (2018)

For more detailed information of the CVB feed evaluation value systems and detailed information about the composition and feeding values of feedstuffs the reader is referred to:

CVB Feed Table 2018
Online Feeding value calculator

The CVB products can be consulted via the CVB website: www.cvbdiervoeding.nl.

8 List with abbreviations

Abbreviation	Unit	Description
afdLYS		Apparent fecal digestible lysine
afdM + C		Apparent fecal digestible methionine + cysteine
ASH	g	Crude ash
BW	g or kg	Body weight
BW ^{0.75}		Metabolic body weight
Ca	g	Calcium
CF or CFIBER	g	Crude fiber
CFAT	g	Crude fat
CFATh	g	Crude fat after acid hydrolysis
CP	g	Crude protein
CYS	g	Cysteine
DM	g	Dry matter
Dig P po	g	Digestible Phosphorus Poultry
FC		Feed conversion (g feed / g body weight)
g		Gram
K	g	Potassium
kcal		Kilocalories
kg		Kilogram
kJ		Kilojoule
LYS	g	Lysine
ME	MJ / kcal	Metabolizable energy
MEbr	MJ / kcal	Metabolizable energy for broilers
MEla	MJ / kcal	Metabolizable energy for laying hens
MEpo	MJ / kcal	Metabolizable energy for poultry
MET	g	Methionine
MJ		Mega joule
N	g	Nitrogen
P	g	Phosphorus
SID		Standardized ileal digestible
STA	g	Starch (enzymatically determined by amyloglucosidase)
SUG	g	Sugars