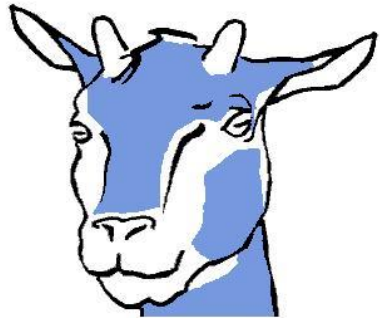
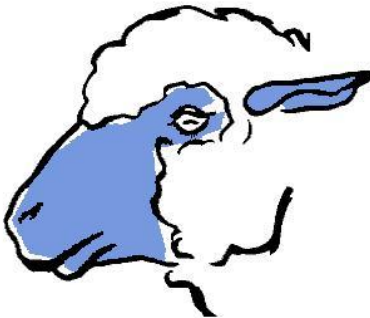
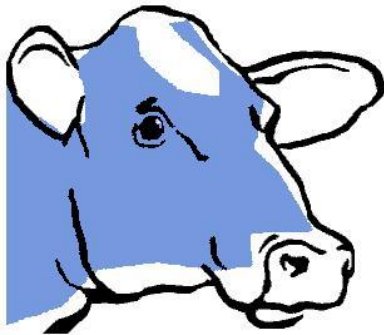


CVB Table Booklet Feeding of Ruminants 2016

**Nutrient requirements for cattle, sheep and goats and
nutritional values of feeding ingredients for ruminants**



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Preface

In 2008, the first edition of the CVB Table Booklet Feeding of Pigs was published. This was the English translation of the chapter on Pig nutrition of the Dutch publication CVB Tabellenboek Veevoeding 2007. Since then updates of this latter publication appeared in 2010, 2012 and 2016. The booklet lying before you is an update of the 2008 version. The most relevant adjustments are briefly summarized below:

- In the CVB Feed Table 2016, the chemical compositions of the feed ingredients for all species and categories of production animals have been actualized. This implies that the Tables 4.2 – 4.4 in this booklet have been actualized too.
- For a better readability, the chemical composition and feeding values of feed ingredients are presented on one page now. This implied that some parameters have been omitted (e.g., FOMp2 and OEB2). These and other parameters (e.g., trace elements and amino acid compositions) can be found in the comprehensive CVB Feed Table 2016. This table can be freely downloaded from the CVB website (<http://www.cvbdievoeding.nl/pagina/10081>).
- Several new feed ingredients have been added (e.g. maize germs in Table 4.2; wheat yeast concentrate, several qualities in Table 4.3; rape seed straw and grass/clover silages in Table 4.4).
- Table 4.5 has been actualised; the table now is based on analyses of Eurofins over the years 2007 until 2011.
- Since 2016, the complete CVB Tabellenboek Veevoeding (in Dutch) has been split into separate booklets for Cows, Sheep and Goats, for Pigs, for Poultry, for Horses and for Rabbits. Of these booklets the editions for Cows, Sheep and Goats, for Pigs and for Poultry are also available in English. It is our goal to make available future editions of these Dutch versions in English as soon as possible.

January 2018.
Wageningen Livestock Research
Wageningen

	<u>Page</u>
Preface.....	3
1. Dairy cattle	6
1.1 Requirements for dairy cattle.....	6
1.1.1 Requirements for maintenance and milk production of adult dairy cattle.....	6
1.1.2 Additional allowance for heifers and 2nd parity cows.....	7
1.1.3 Additional allowance for pregnant cows	10
1.1.4 Nutrition after calving	10
1.2 Requirements for female young stock	10
1.3 General recommendations dairy cattle	12
1.3.1 Structure value.....	12
1.3.2 Dry matter intake dairy cattle	13
1.3.3 Dry matter intake young stock.....	15
1.3.4 Requirements of minerals, trace elements and vitamins	16
1.4 Breeding bulls.....	19
1.5 Beef cattle	19
1.5.1 Young beef cattle (bulls)	20
1.5.2 Double-muscled type	23
1.5.3 Fattening of dairy cattle.....	23
1.5.4 Allowance of a OEB shortage	23
2. Sheep.....	24
2.1 Maintenance requirement.....	24
2.2 Standards for ewes.....	24
2.2.1 Pregnant and lactating ewes.....	24
2.2.2 Young ewes (up to approximately 1.5 years)	25
2.3 Standards for fattening lambs	26
2.4 Requirements of minerals and trace elements for sheep	26
3. Goats.....	27
3.1 Energy and protein requirements for goats	27
3.2 Dry matter intake goats.....	28
3.3 Requirements of minerals and micro-elements for goats	28
4. Feed ingredients.....	29
4.1 General explanation	29
4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)	30
4.3 Wet by-products (DM in g/kg product; VEM, VEVI, VW en SW per kg dry matter; other nutrients and feeding values in g/kg DM).....	37
4.4 Roughage for ruminants (DM in g/kg product; VEM, VEVI, VW and SW per kg dry matter; other nutrients and feeding values in g/kg dry matter).....	39
4.5a Average and limit values of minerals in meadow grass, grass silage and maize silage, corn cob with bracts, (ensiled), whole crop silage (cereals) and green cereal plant silages, destined for animal nutrition for ruminants	45
4.5b Average and limit values of trace elements in meadow grass, grass silage and maize silage, corn cob with bracts, (ensiled), whole crop silage (cereals) and green cereal plant silage, destined for animal nutrition for ruminants.....	46
4.6 Minerals.....	47

5.	Relevant CVB publications	48
6.	List with abbreviations	49

1. Dairy cattle

1.1 Requirements for dairy cattle

1.1.1 Requirements for maintenance and milk production of adult dairy cattle

The requirements for dairy cattle are based on the equations given below:

1.1.1.1 Net Energy requirement (VEM)

(1 VEM = 6.9 kJ Net Energy for lactation):

VEM (per day) for maintenance and milk production:

$$\bullet \quad \text{VEM} = (42.4 \times \text{BW}^{0.75} + 442 \times \text{CM}) \times \{1 + (\text{CM} - 15) \times 0.00165\}$$

BW = body weight in kg;

CM = milk corrected for fat (FCM) or fat and protein (FPCM)

For a lactating cow with a body weight of 650 kg, the VEM requirement can be estimated with the following equation:

$$\bullet \quad \text{VEM}_{\text{maintenance+production}} = 5323 + 440 \times \text{CM} + 0,73 \times \text{CM}^2 \quad (\text{VEM/day})$$

For each 50 kg above or below 650 kg, the requirements should be increased, respectively decreased, by 320 VEM per day.

1.1.1.2 Calculation of FCM and FPCM

CM in the equations above is the milk production in kg per day, expressed as milk with 4% of fat and 3.3% of protein (standard milk).

For a long time, there is a correction possibility for fat (FCM) to calculate the VEM-requirements for milk production with a fat content other than 4%. Later on it was found that the ratio between the fat and protein content differs that much that it is eligible to introduce a correction for fat and protein.

To convert milk with certain percentages of fat and protein into standard milk, the following equations apply:

- fat corrected milk (containing 3.3 % protein):

$$\text{FCM} = (0.4 + 0.15 \times \%F) \times M$$

- fat and protein corrected milk:

$$\text{FPCM} = (0.337 + 0.116 \times \%F + 0.06 \times \%P) \times M$$

M = actual milk production in kg per day;

%F = fat percentage;

%P = protein percentage

FPCM is more accurate than FCM only if the protein content differs more than 0.3 % from the contents given in Table 1.2. A correct application of the standards is required (in other words: no under-nutrition or use of unbalanced amounts of nutrients).

1.1.1.3 Protein requirement

1.1.1.3.1 Requirement of intestinal digestible protein (DVE)

Maintenance:

- $DVE_{\text{maintenance}} \text{ (g/day)} = (2.75 \times BW^{0.5} + 0.2 \times BW^{0.6})/0.67$

For practical use, the following equation for $DVE_{\text{maintenance}}$ can be applied:

- $DVE_{\text{maintenance}} = 54 + (0.1 \times BW) \text{ (g/day)}$

Milk production:

- $DVE_{\text{milk production}} \text{ (g)} = 1.396 \times Pr + 0.000195 \times Pr^2$

Pr = milk protein production in g/day

= milk protein content in g/kg × kg produced milk/day

Rumen degraded protein balance (OEB)

The rumen degraded protein balance reflects the difference between the potential microbial protein synthesis based on degraded feed crude protein and that based on energy available for fermentation in the rumen. The DVE/OEB 2007 system distinguishes between an OEB deficit on the short-term (= OEB-2; two hours after feed intake)) and on the long-term (= OEB-value).

The OEB of a ration for dairy cows should never be negative (that is to say neither on the short nor on the long term. When the OEB is negative, microbial synthesis may be impaired, because of a shortage of N in the rumen. On the other hand, when the OEB is positive, the loss of nitrogen to the animal increases proportional to the OEB value. In that situation, also extra energy is needed for detoxification of ammonia (conversion into urea).

The VEM and DVE requirements for a lactating cow **with a body weight of 650 kg** calculated with the equations above are given in Table 1.2, for a number of milk production levels and a number of milk fat and milk protein contents.

1.1.2 Additional allowance for heifers and 2nd parity cows

Lactating heifers (first parity cows) and 2nd parity cows are still growing during the lactation periods. The required additional VEM and DVE for this growth are given in Table 1.1.

Table 1.1 Additional VEM and DVE allowances during lactation for young dairy cattle.

	BW mean ¹⁾	Additional allowance (per day)	
		VEM	g DVE
1st parity cow	540 kg	660	37
2nd parity cow	595 kg	330	19

¹⁾ The body weight presented is the mean weight shortly after calving.

When taking into account the body weight and additional allowance, it appears that in practice the same VEM standards may be applied to these young animals as for adult cows.

Table 1.2 Standards for the energy and protein requirements of dairy cattle when indoor-fed¹⁾. Body weight: 650 kg. The units are VEM/day, g DVE/day and kg milk/day.

% fat	3,50		3,75		4,00		4,25		4,50		4,75		5,00	
% protein	3,03		3,18		3,32		3,45		3,60		3,75		3,88	
kg milk	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE
1	5730	160	5750	160	5760	170	5780	170	5800	170	5810	170	5830	170
2	6140	200	6170	210	6210	210	6240	220	6270	220	6310	220	6340	230
3	6550	250	6600	250	6650	260	6700	270	6750	270	6800	280	6850	280
4	6960	290	7030	300	7100	310	7160	320	7230	320	7300	330	7360	340
5	7370	340	7460	350	7540	360	7620	370	7710	380	7790	390	7880	400
6	7790	380	7890	390	7990	410	8090	420	8190	430	8290	440	8390	450
7	8200	420	8320	440	8440	450	8560	470	8680	480	8800	500	8910	510
8	8620	470	8760	490	8890	500	9020	520	9160	540	9300	560	9430	570
9	9040	510	9190	530	9340	550	9490	570	9650	590	9800	610	9960	630
10	9460	560	9630	580	9800	600	9970	620	10140	650	10310	670	10480	690
12	10300	650	10500	680	10710	710	10910	730	11120	760	11330	790	11530	810
14	11140	750	11390	780	11630	810	11870	840	12110	870	12360	910	12600	940
16	11990	840	12280	880	12550	920	12830	950	13110	990	13390	1030	13670	1060
18	12850	940	13170	980	13480	1020	13790	1060	14110	1110	14430	1150	14740	1190
20	13710	1040	14070	1090	14420	1130	14760	1180	15120	1230	15480	1280	15830	1320
22	14580	1140	14970	1190	15360	1240	15740	1290	16140	1350	16540	1400	16920	1450
24	15450	1240	15880	1300	16310	1360	16730	1410	17160	1470	17600	1530	18020	1590
26	16330	1340	16800	1410	17260	1470	17720	1530	18190	1600	18670	1670	19130	1730
28	17210	1440	17720	1520	18220	1590	18720	1650	19230	1720	19750	1800	20250	1870
30	18090	1550	18640	1630	19180	1700	19720	1770	20270	1850	20830	1940	21370	2010
32	18980	1660	19570	1740	20160	1820	20730	1900	21320	1990	21920	2080	22500	2150
34	19880	1760	20510	1860	21130	1940	21750	2030	22380	2120	23020	2220	23640	2300
36	20780	1870	21450	1970	22110	2070	22770	2150	23450	2260	24130	2360	-	-
38	21690	1990	22400	2090	23100	2190	23800	2280	24520	2390	25240	2500	-	-
40	22600	2100	23350	2210	24100	2320	24830	2420	25590	2530	-	-	-	-

% fat	3,50		3,75		4,00		4,25		4,50		4,75		5,00	
% protein	3,03		3,18		3,32		3,45		3,60		3,75		3,88	
kg milk	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE
42	23520	2210	24310	2330	25100	2440	25870	2550	26680	2680	-	-	-	-
44	24440	2330	25270	2450	26100	2570	26920	2690	-	-	-	-	-	-
46	25360	2440	26240	2580	27110	2710	27970	2830	-	-	-	-	-	-
48	26290	2560	27220	2700	28130	2840	-	-	-	-	-	-	-	-
50	27230	2680	28200	2830	29150	2970	-	-	-	-	-	-	-	-

¹ The maintenance requirement (5323 VEM + 119 g DVE) is included in the standards. This maintenance requirement applies to a dairy cow with a body weight of 650 kg and is based on research with (tied) animals in respiration chambers. Which allowances should be taken in other situations is difficult to indicate as solid data are not available.

For (dairy) cows in free stall barns and cows with (restricted) access time to pasture there are not enough experimental data on the additional energy expenditure for walking and grazing for precise adjustment of the VEM and DVE requirements. With day and night grazing it is recommended already for many years that the maintenance standard should be increased by approximately 20%.

1.1.3 Additional allowance for pregnant cows

The energy and protein requirements for gestation are very low during the first 5 months. For gestating cows, additional energy and protein should be given from the 6th month of gestation for the growth of the calf, uterus, amnion and chorion, et cetera. Table 1.3 represents the **additional allowances** for VEM and DVE from the 6th month of gestation for a cow with a body weight of 650 kg.

Table 1.3 Additional VEM and DVE allowances (per day), on top of the standards for maintenance and milk production, for dairy cattle from the 6th month of gestation.^{1) 2)}

Month in gestation	Additional allowance (per day)	
	VEM	g DVE
6 th month	450	60
7 th month	850	105
8 th month (dry)	1500	180
9 th month (dry)	2700	280

¹⁾ The additional allowance is for a single gestation, where it is assumed that the body condition of the cow does not change. When an improvement of body condition is to be realized during the dry period, this may start about one week after drying off. The improvement should be achieved in the following 3.5 weeks (month 8 of pregnancy). Increments of the body condition score with 1 point (of a 5-point scale) requires an additional energy intake of approximately 5500 VEM/day on top of the requirements given in the table. See also CVB Documentation report nr. 27.

²⁾ For a twin gestation, the additional allowances are 1.7 times higher for energy, and 1.8 times higher for protein.

The last week before calving, 1 kg of concentrate may be added to the ration, for adaptation purposes. The roughage part of the ration should - as much as possible - be similar to the roughage diet after calving.

It is advised to provide 2 kg of concentrate on the day of calving.

An excessive condition (score 4 and higher) around calving should be avoided.

1.1.4 Nutrition after calving

After calving it is recommended to increase the amount of concentrates with 1 kg per day until (if necessary) the level of 8 kg is reached (for heifers: 6 kg); subsequently, the concentrate allowance is increased by 0.5 kg per day, until the standard or the maximum intake is achieved.

It is recommended to bring fresh cows on a high level of production, by giving them during the first two months of lactation unrestricted access to a high quality diet. This is beneficial for the total year production. However, it should be noted that the risk of consuming insufficient roughages increases, especially when large amounts of concentrates are provided the risk of nutritional disorders might increase (also see paragraph 1.3.2).

1.2 Requirements for female young stock

The recommended growth schedule (Table 1.4) for female young stock is aimed at heifers calving at the age of 2 years, at a body weight of approx. 530 kg immediately after calving. This can be realized by feeding the young stock according to the standards given in Table 1.5.

Table 1.4 Recommended growth schedule for young stock.

Age (months)	Daily gain (g/day)
Milk period (until 3 months)	approx. 550
3 – 8	approx. 850
9 – 15	approx. 700
16 – 21	600 – 650
22 → 24	500 → 150 (decreasing)

Table 1.5 Standards¹⁾ for the nutrient requirements with indoor-feeding of young stock destined for dairy cattle ^{2) 3)}

		Daily gain g per day ⁵⁾						additional VEM when grazing
Age (months)	BW (kg)	850		700		625		
		VEM	DVE	VEM	DVE	VEM	DVE	
2	75	2500	225	2250	195	-	-	250
4	130	3200	255	2950	225	-	-	350
6	185	3850	285	3500	250	-	-	450
8	235	4600	305	4150	270	-	-	550
10	280	5400	325	4850	290	-	-	600
12	320	-	-	5400	310	5100	290	650
14	360	-	-	5900	330	5600	310	750
16	400	-	-	6450	350	6100	335	800
18	440	-	-	7000	375	6650	355	850
20 ⁴⁾	480	-	-	7700	435	7300	415	950
22 ⁴⁾	BW 510 (app. 500 g gain/day ⁵⁾)				7500 VEM; 460 g DVE			1050
23 ⁴⁾	Late gestation (approx. 350 g gain/day ⁵⁾)				7500 VEM; 460 g DVE			1100
24 ⁴⁾	Late gestation (approx. 150 g gain/day ⁵⁾)				7500 VEM; 460 g DVE			1150

¹⁾ The standards for VEM and DVE (in g) are on a daily basis. The standards for female young stock have been substantiated in CVB Documentation report nr. 19: "Energie en eiwitnormen voor de voederbehoefte van vrouwelijk jongvee bestemd voor de melkveehouderij (1997).

²⁾ When grazing, the VEM requirements for maintenance are app. 15% higher. The additional allowance for grazing is given in the last column.

³⁾ The **bold** figures represent the standards for the nutrient requirement at the desired growth rate (also see Table 1.4).

⁴⁾ From the 20th month, the standards include an additional VEM and DVE allowance for pregnancy. For the additional VEM and DVE allowances, it is assumed that the growth curve of a fetus of a yearling is 90% of the growth curve of a fetus of adult dairy cattle. The additional VEM allowances in the 20th, 22nd, 23rd and 24th month are 250, 700, 1150 and 1950 VEM per day, respectively. The additional DVE allowance in the 20th, 22nd, 23rd and 24th month is 30, 90, 150 and 235 g DVE per day, respectively.

⁵⁾ This concerns (also for gestation) only the weight gain of the dairy cow, excluding uterus contents.

A negative OEB is permitted from 250 kg BW in case of a surplus DVE supply: 0 g OEB/day at 250 kg body weight up to -62 g OEB/day at 500 kg body weight (see also paragraph 1.5.4).

1.3 General recommendations dairy cattle

1.3.1 Structure value

In the CVB feed ingredient tables for each ingredient a structure value (SW) is presented. The structure value of the ration for a standard cow (25 kg of milk, 1st, 2nd or 3rd lactation) should be at least 1.00 when concentrates are fed twice a day. Some corrections are necessary for other situations (see table 1.6).

Table 1.6 Structure value requirements for dairy cattle.

Animal characteristics	SW diet
Cow	≥ 1.00
25 kg milk with 4,4% fat 1st, 2nd of 3th lactation - Concentrate fed twice daily	
Correction for:	
Different milk production and fat contents ¹⁾ :	
- More (resp. less) than 25 kg (correction per kg milk) - Fat contents higher (resp. lower) than 4.4 % (correction per % fat)	+ (resp. -) 0.008 - (resp. +) 0.050
Different age	
4th lactation 5th lactation and higher	-0.08 -0.10
Distributed supply of concentrates (at least six times per day) or total mixed ration (TMR)	-0.10

¹⁾ If the milk fat% is unknown or when a correction of a deviating milk fat % is difficult to make, it is advised to take into account for each kg milk more resp. less than 25 kg a correction of + (resp. -) 0.010.

The structure value (SW) (per kg DM) of a ration is calculated as follows:

$$SW_{\text{ration}} = \frac{(\text{kg DM roughage} \times SW_{\text{roughage}}) + (\text{kg DM concentrates} \times SW_{\text{concentrates}})}{\text{total DM intake in kg}}$$

Numeric example

As an example, the structure value (SW) of a ration consisting of 60% grass silage and 40% concentrates is calculated below. The SW of grass silage is assumed to be 2.45; the SW of the concentrate feed is assumed to be 0.30. The structure value of the complete ration then becomes:

$$SW_{\text{ration}} = \frac{(8.9 \text{ kg DM} \times 2.45) + (11.5 \text{ kg DM} \times 0.30)}{20.6} = 1.23$$

Next, the structure requirement is calculated for a second lactation cow, producing 32 kg of milk per day (containing 4.2% of fat). Concentrates are fed twice a day.

The structure requirement for this cow is:

$$\begin{aligned}
 SW_{\text{requirement}} &= 1.0 + (\text{milk production} - 25) \times 0.008 - (\% \text{fat} - 4.4\%) \times 0.050 \\
 &= 1.0 + (32 - 25) \times 0.008 - (4.2\% - 4.4\%) \times 0.050
 \end{aligned}$$

$$= 1.0 + 0.056 + 0.010 = 1.066$$

The example-ration therefore contains sufficient structure for this cow.

1.3.2 Dry matter intake dairy cattle

1.3.2.1 Dry matter intake adult dairy cattle

The feed intake of adult dairy cattle is estimated with the 'Feed Intake Model 2007'. For more information one is referred to CVB Documentation report nr. 51 (2007) (in Dutch).

To estimate the total dry matter intake per day (TDMI) of a certain ration, the feed intake capacity (FIC) of a cow (expressed in Fill Units ("Verzadigingswaarde" in Dutch; VW) is divided by the Satiety Value of the ration (VW_{ration} in satiety units per kg DM).

In formula:

$$\text{TDMI} = \text{FIC} / \text{VW}_{\text{ration}} \quad (\text{kg DM/day})$$

To estimate the feed intake capacity of a 'standard cow' the following formula is used:

$$\text{FIC} = [8.743 + 3.563 \times (1 - e^{-1.140 \times a})] \times e^{0.3156 \times (1 - e^{-0.05889 \times d})} \times (1 - 0.05529 \times (g/220))$$

In which:

- FIC = Feed intake capacity (VW/day)
- a = Lactation age = parity - 1 + (days in lactation/365)
- d = Days in lactation
- g = Days in gestation

From this formula, it appears that the feed intake capacity, except for a number of coefficients derived from statistical analysis, depends on the following factors: (lactation) age (a), days in lactation (d), and the number of days the cow is in gestation (g). These variables must be inserted for each situation to be calculated.

The satiety value of a ration is estimated by fractional adding of the satiety values of the ration components. The contribution of a ration component depends on (the characteristics) of the component and the proportion in which it is included in the ration. This means that the satiety value (VW) of a ration (per kg DM) can be calculated as follows:

$$\text{VW}_{\text{ration}} = (\text{proportion roughage}_1 \text{ in ration} \times \text{VW roughage}_1) + (\text{proportion roughage}_2 \text{ in ration} \times \text{VW roughage}_2) + (\text{proportion concentrate}_1 \text{ in ration} \times \text{VW concentrate}_1) + (\text{proportion concentrate}_2 \text{ in ration} \times \text{VW concentrate}_2) + \text{etc.}$$

For a ration that, on dry matter basis, consists of 60% grass silage with a VW of 1.08 per kg DM and 40% of a concentrate with a VW of 0.34 per kg DM, the satiety value of the ration will be:

$$\text{VW}_{\text{ration}} = (60/100 \times 1.08) + (40/100 \times 0.34) = 0.648 + 0.136 = 0.784 = 0.78 \text{ per kg DM}$$

Depending on the type of feed ingredient, different formulas are used to estimate the satiety value. These formulas have been derived from feeding trials in which these ingredients were fed. In a number of cases, pragmatic choices were made. For more information concerning the satiety value of feed ingredients, one is referred to the tables in Chapter 4 of this publication.

In table 1.7 the feed intake capacity is shown for a number of non-pregnant cows in different stages of lactation and with different lactation numbers. The feed intake capacity is expressed as satiety values per day.

Table 1.7 Effect of lactation stage and lactation number on the feed intake capacity (FIC) of non-pregnant dairy cattle

Lactation number	Feed intake capacity (FIC in VW units per day) in relation to number of days in lactation				
	1	60	120	180	305
1	8.9	12.7	13.5	14.1	15.0
2	11.4	15.4	15.8	16.0	16.3
3	12.2	16.3	16.5	16.6	16.7
>3	12.5	16.7	16.8	16.8	16.9

For a 2nd lactation cow, the total dry matter intake (TDMI, kg/day) of the above-mentioned ration (grass silage / concentrates = 60/40, VW = 0.78 per kg DM) at day 120 of lactation is therefore estimated to be: $TDMI = FIC/VW_{\text{diet}} = 15.8/0.78 = 20.3$ kg DM/day.

1.3.2.2 Dry matter intake dry cows

For dry cows in their 8th and 9th month of gestation, the feed intake capacity is shown in Table 1.8.

Table 1.8 Feed intake capacity (FIC) of dry cows in the 8th and 9th month of gestation for various lactation numbers.

Lactation number	Feed intake capacity (VW units per day)	
	8 th month of gestation	9 th month of gestation
1	14.2	13.5
2	15.4	14.4
> 2	15.7	14.7

1.3.2.3 Substitution of roughage by concentrates

Feeding concentrates as supplement to roughage based rations results in a reduction of roughage intake. The repression rate depends on the satiety values of the roughage and the concentrate and can be calculated as: $VW_{\text{concentrate}}/VW_{\text{roughage}}$.

The intake of concentrates confiscates part of the feed intake capacity of the cow and – therefore – represses part of the roughage intake. Most concentrates have a satiety value of approx. 0.4 VW units per kg DM.

This implies that for a grass silage based ration (with, e.g., a VW of 1.0 units/kg DM) the intake of each kg standard concentrate causes a repression of 0.4 kg DM intake of grass silage. In rations with roughages with a relative low VW, such as maize silage of fresh grass, the repression of roughage will be stronger. For a roughage with a VW of 0.8 VW units/kg DM, each kg of 'average' concentrate will repress 0.5 kg DM of roughage.

1.3.3 Dry matter intake young stock

The DM intake of young stock from hay, grass silage, and (ensiled) maize varies between 1.5 and 3.0 kg DM per 100 kg BW, assuming good quality roughage. For moderate quality roughage, the intake will be lower.

The DM intake per 100 kg BW decreases with increasing age and also depends on the quality of the feedstuff. Table 1.9 shows how much young stock will consume of a roughage with a certain quality, provided that no concentrates are fed (= the gross DM intake, GDM).

If the energy supply from roughage alone is not sufficient to achieve the target growth (column growth/day), additional supply of concentrate is required. This additional concentrate will substitute roughage. The intake or roughage corrected for substitution by concentrate is shown in column 'Roughage'.

If energy supply from roughage alone exceeds the energy requirements to achieve the target growth, then the (underlined) figures in column 'roughage' indicate the amount of that roughage sufficient to meet the requirements.

Table 1.9 Gross DM intake from roughages (GDM) and net roughages intake in kg DM per animal per day with matching concentrates supply (app. 90% dry matter and 940 VEM) in kg per animal per day, for indoor-fed young stock, depending on body weight, desired growth rate, and VEM content in the roughages.

		VEM/kg DM roughage					
		450 ¹⁾			750		
BW (kg)	Growth (g/day)	GDM	Roughage (kg DM/day)	Concentrate	GDM	Roughage (kg DM/day)	Concentrate
100	850	-	-	-	2.4	1.4	2.0
200	850	3.0	1.9	3.3	4.2	3.6	1.5
300	700	4.2	3.3	3.6	5.6	5.1	1.3
400	625	5.2	4.3	4.2	6.7	6.2	1.5
500	500	6.0	5.3	5.1	7.7	7.2	2.1

		VEM/kg DM roughage					
		850			950		
BW (kg)	Growth (g/day)	GDM	Roughage (kg DM/day)	Concentrate	GDM ²⁾	Roughage (kg DM/day)	Concentrate
100	850	2.8	1.5	1.8	3.2	1.6	1.6
200	850	4.7	4.6	0.2	5.2	<u>4.3</u>	0.0
300	700	6.1	<u>5.9</u>	0.0	6.6	<u>5.3</u>	0.0
400	625	7.3	<u>7.2</u>	0.0	7.9	<u>6.4</u>	0.0
500	500	8.3	8.2	0.4	9.0	<u>7.8</u>	0.0

1) Wheat straw.

2) In pastures of 950 VEM/kg DM, the gross DM intake is 10% higher than the forages intake indoor.

With other growth rates, adjustments need to be made on the figures given in Table 1.9.

From Table 1.9 it appears that when roughage contains more than 850 VEM per kg DM should often be fed restricted, or should be supplemented with roughage low in energy (e.g., straw).

Next to the DM intake, some practical starting points are of interest when feeding young stock:

1. In practice, the following is taken into account in the nutritional management of calves (also considering the minerals and vitamins supply).
 - Aim to achieve that the calves consume 0.75 to 1 kg of concentrates given *ad libitum* during the milk period at the time of weaning.
 - After weaning at approx. 75 kg BW, increase the concentrates supply as quickly as possible to 2 kg per animal per day.
 - Slowly decrease the concentrates supply during grazing to a minimum amount at the age of 6 to 7 months. The minimum amount depends on the quality of the grass offered, and may be zero.
 - Slowly reduce the concentrate supply during indoor-feeding to a minimum amount at the age of 7 to 9 months. Also in this case, the minimum amount depends on the nutritional value of the forages offered.

In Table 1.9 the above is taken into account for the 100 kg BW animal.

2. As the feed intake capacity decreases when gestation progresses, it is recommended to offer at least 1 kg of concentrate to the animals in the last month of gestation. Supplying concentrates shortly before calving also smoothens the transition to the lactation diet. This decline in feed intake capacity is not accounted for in Table 1.9.

1.3.4 Requirements of minerals, trace elements and vitamins

For detailed information on the requirements of minerals and trace elements for dairy cattle and female young stock, the reader is referred to the “Handleiding Mineralenvoorziening rundvee, schapen, geiten” (CVB, 2005) (In Dutch).

1.3.4.1 Mineral requirements for adult dairy cattle (BW 650 kg)

Table 1.10 shows, for a number of situations, the requirements of minerals and trace elements for adult dairy cattle.

Table 1.10 Requirements of minerals and trace elements for adult dairy cattle*

Table 10.a: Dry cows

Element	Unit	Dry, 8 – 3 weeks before calving ¹⁾		Dry, 3- 0 weeks before calving ²⁾	
		per day	per kg DM	per day	per kg DM
Calcium (Ca)	g	27	2.4	31	2.8
Phosphorus (P)	g	21	1.9	22	2.0
Magnesium (Mg)	g	22	1.9	23	2.1
Sodium (Na)	g	7.6	0.7	6.6	0.6
Potassium (K)	g	56	4.9	55	5.0
Chlorine (Cl)	g	7.7	0.7	8.5	0.8
Sulphur (S)	g		1.5		1.5
Copper (Cu)	mg	277	24.1	277	25.2
Cobalt (Co)	mg	1.2	0.1	1.1	0.1
Iodine (J)	mg	5.5	0.1	5.5	0.1
Zinc (Zn)	mg	246	21.4	246	22.4
Manganese (Mn)	mg	460	40	440	40
Iron (Fe)	mg	345	30.0	345	31.4
Selenium (Se)	mg	1.44	0.13	1.44	0.13

Table 10.b: Lactating cows

Element	Unit	Lactating, 20 kg/day ³⁾		Lactating, 40 kg/day ⁴⁾	
		per day	per kg DM	per day	per kg DM
Calcium (Ca)	g	60	3.2	100	4.2
Phosphorus (P)	g	47	2.5	79	3.3
Magnesium (Mg)	g	38	2.1	56	2.4
Sodium (Na)	g	20	1.1	33	1.4
Potassium (K)	g	134	7.2	190	8.1
Chlorine (Cl)	g	37	2.0	66	2.8
Sulphur (S)	g		2.0		2.0
Copper (Cu)	mg	227	12.2	260	11.1
Cobalt (Co)	mg	1.9	0.1	2.4	0.1
Iodine (J)	mg	9.5	0.5	12	0.5
Zinc (Zn)	mg	490	26.5	763	32.5
Manganese (Mn)	mg	740	40	940	40
Iron (Fe)	mg	150	8.1	300	12.8
Selenium (Se)	mg	2.72	0.15	4.22	0.18

* For dairy cattle rations the next energy values are assumed per kg DM: 800, 920, 920, and 970 VEM for dry 8-3, dry 3-0, lactating 20 kg, and lactating 40 kg, respectively.

¹⁾: Feed intake 11.5 kg DM/day;

²⁾: Feed intake 11.0 kg DM/day;

³⁾: Feed intake 18.5 kg DM/day;

⁴⁾: Feed intake 23.5 kg DM/day.

1.3.4.2 Mineral requirements for female stock

Table 1.11 shows, for a number of situations, the requirements of minerals and trace elements for female young stock.

Table 1.11 Requirements of minerals and trace elements for female young stock.*

Element	Unit	4 months (850 g gain/day) ¹⁾		9 months (700 g gain/day) ²⁾		16 months (625 g gain/day) ³⁾	
		per day	per kg DM	per day	per kg DM	per day	per kg DM
Calcium (Ca)	g	22	5.6	20	3.5	21	2.8
Phosphorus (P)	g	13	3.4	13	2.3	13	1.8
Magnesium (Mg)	g	6.7	1.7	10	1.8	14	1.9
Sodium (Na)	g	2.3	0.6	3.0	0.5	4.0	0.5
Potassium (K)	g	17	4.3	26	4.6	35	4.9
Chlorine (Cl)	g	2.2	0.6	3.3	0.6	4.6	0.6
Sulphur (S)	g		1.5		1.5		1.5
Copper (Cu)	mg	56	14.5	92	16.4	132	18.1
Cobalt (Co)	mg	0.4	0.1	0.6	0.1	0.7	0.1
Iodine (J)	mg	2.0	0.5	3.0	0.5	3.5	0.5
Zinc (Zn)	mg	111	28.5	143	25.5	183	25.1
Manganese (Mn)	mg	98	25	140	25	183	25
Iron (Fe)	mg	363	93.2	299	53.4	267	26.6
Selenium (Se)	mg	0.40	0.10	0.62	0.11	0.87	0.12

* In the calculations, the body weights assumed at 4, 9 and 16 months of age: 130 kg, 260 kg and 400 kg respectively (see table 1.5).

¹⁾: Feed intake 3.9 kg/day;

²⁾: Feed intake 5.6 kg/day;

³⁾: Feed intake 7.3 kg/day.

1.3.4.3 Requirements of some vitamins for adult dairy cattle

Table 1.12 Gross requirements for adult cattle of minerals, trace elements and vitamins

Requirement (in formula)			Required contents per kg DM of the diet	Unit
Vit. A	24000 + 1500 x M	IE	2000 – 3500 ¹⁾	IE
Vit. D	10 x BW	IE	300 – 500 ²⁾	IE

BW: Body Weight in kg; M: milk yield in kg/day

¹⁾ Highest value at a high milk yield per day.

²⁾ Highest value during dry off period.

1.3.4.4 Concentrates for cattle

For the contents of minerals and trace elements in feedstuffs (roughages, wet by-products and concentrate ingredients) one is referred to Chapter 4. Table 1.13 represents indicative contents for Ca, P, Na and Mg in concentrates for cattle, as used in The Netherlands

Table 1.13 The range of mineral and trace element contents in concentrates for dairy cattle¹⁾

Mineral	Unit	Contents per kg DM		
		Standard feed; 940 VEM / 90 DVE	Protein-rich feed, 940 VEM / 120 DVE	High protein feed ^{a)} , 900 VEM / 200 DVE
		range	range	range
Ca	g	7.0 – 10.0	7.5 - 9.5	12.0 - 14.0
P	g	4.0 - 5.5	5.5 – 7.0	7.0 - 8.5
Mg	g	4.5 - 7.0	5.0 - 7.5	5.5 - 8.5
Na	g	3.0 - 4.0	3.0 - 4.5	4.0 – 6.0
K	g	14.0 – 19.0	15.0 - 21.5	18.0 – 22.0
Cl	g	4.0 - 6.5	4.0 – 7.0	5.0 - 9.0
S	g	2.1 - 3.2	2.8 - 4.3	3.4 - 5.6
Cu	mg	20 - 35	25 - 45	45 - 65
Co	mg	0.2 - 1.2	0.2 - 1.6	1.0 - 2.6
I	mg	1.3 – 2.0	1.5 - 2.3	2.1 - 4.7
Zn	mg	60 - 100	60 - 130	100 - 180
Mn	mg	105 - 175	100 - 170	120 - 190
Se	mg	0.25 - 0.45	0.25 - 0.65	0.45 - 1.55
Fe	mg	225 - 510	270 - 530	275 - 480

a) Supplementary concentrate fed in maize silage based rations.

Source: "Handleiding Mineralenvoorziening Rundvee, Schapen, Geiten" (CVB, 2005).

1.4 Breeding bulls

The nutrient requirements may vary strongly between bulls. In an intensive breeding season, somewhat higher amounts of feed may be offered. For young breeding bulls up to 1 year of age, the standards for female young stock may be applied.

Table 1.14 Energy and protein requirements for breeding bulls¹

Age	BW (kg)	VEM	DVE (g)
ca. 1 year ²⁾	400	5400	300
adult	900	7200	150
adult	1100	8200	165

1) The values given for VEM and DVE are expressed per day.

2) A growth rate of approx. 600 g/day is assumed.

1.5 Beef cattle

Below the energy and protein requirements for beef cattle are shown. For the mineral and trace elements one is referred to "Handleiding Mineralenvoorziening Rundvee, Schapen, Geiten" (CVB 2005).

With respect to the nutrient requirements of beef bulls a distinction is made for the energy (VEI) and protein (DVE) requirements of different types of beef bulls: early maturing types (Table 1.15), intermediate types (Table 1.16), and late- maturing types (Table 1.17). These

VEVI and DVE standards are based on CVB Documentation report nr. 11 (December 1994): "Herziening van de energie- en eiwitnormen voor vleesstieren".

In 1998, a new structure value system for ruminants is introduced. As this (Belgium) research is not finished yet, for the time being a structure value of 0.75 for beef bull diets is recommended.

The standards for beef bulls in table 1.15 to table 1.17 apply for diets without additives (Since January 2006 antibiotics are forbidden). Concentrates for beef bulls contain app. 1000 VEVI/ kg product.

The DM-intake from roughage is app. 1.5 kg DM per 100 kg body weight, next to 2 to 3 kg of concentrates.

1.5.1 Young beef cattle (bulls)

Table 1.15 Feeding standards for beef bulls: early maturing type (Holstein-Friesian, Maas Rijn en IJsselveen (MRIJ))¹⁾.

BW ²⁾	DM-intake ³⁾	Gain (g/day)					
		1000		1100		1200	
(kg)	(kg/day)	VEVI	DVE	VEVI	DVE	VEVI	DVE
100	2.0 – 3.0	2950	280	3100	300	3300	320
150	3.0 – 4.0	3650	305	3850	325	4050	345
200	4.0 – 5.0	4250	325	4500	345	4750	365
250	5.0 – 6.0	4900	340	5150	365	5400	385
300	5.5 – 7.0	5500	360	5750	380	6050	405
350	6.0 – 7.5	6100	380	6400	400	6750	420
400	6.5 – 8.0	6700	405	7050	425	7450	445
450	7.0 – 8.5	7350	430	7750	450	8150	470
500	7.5 – 9.5	8050	465	8500	480	8950	490
550	8.0 – 10.0	8800	490	9350	500	9900	500
600	8.5 – 10.5	9700	490	10350	480	-	-

BW ²⁾	DM-intake ³⁾	Gain (g/day)							
		1300		1400		1500		1600	
(kg)	(kg/day)	VEVI	DVE	VEVI	DVE	VEVI	DVE	VEVI	DVE
100	2.0 – 3.0	-	-	-	-	-	-	-	-
150	3.0 – 4.0	4250	370	-	-	-	-	-	-
200	4.0 – 5.0	5000	390	5250	410	-	-	-	-
250	5.0 – 6.0	5700	405	5950	425	6250	445	-	-
300	5.5 – 7.0	6400	425	6700	445	7000	460	7350	480
350	6.0 – 7.5	7100	440	7450	460	7800	475	8200	490
400	6.5 – 8.0	7800	460	8200	475	8650	490	9050	505
450	7.0 – 8.5	8600	485	9050	495	-	-	-	-
500	7.5 – 9.5	9500	500	-	-	-	-	-	-
550	8.0 – 10.0	-	-	-	-	-	-	-	-
600	8.5 – 10.5	-	-	-	-	-	-	-	-

- 1) The values for VEVI and DVE (in g) are given per day. The feeding standards matching the desired growth rate from 150 kg live weight onward are viewed in **bold**. The animals are ready for slaughter at a body weight of approx. 550 kg.
- 2) BW = body weight
- 3) DM = dry matter

Table 1.16 Feeding standards for beef bulls: intermediate type (crossbred of early maturing and beef bulls)¹⁾.

BW ²⁾	DM-intake ³⁾	Gain (g/day)					
		1000		1100		1200	
(kg)	(kg/day)	VEVI	DVE	VEVI	DVE	VEVI	DVE
100	2.0 – 3.0	2900	280	3050	300	3250	325
150	2.5 – 4.0	3550	305	3750	325	3950	350
200	3.5 – 5.0	4200	325	4400	350	4600	370
250	4.5 – 6.0	4800	340	5000	365	5250	390
300	5.0 – 7.0	5350	360	5600	385	5850	405
350	5.5 – 7.5	5900	380	6200	400	6500	425
400	6.0 – 8.0	6500	400	6800	420	7100	445
450	6.5 – 8.5	7050	425	7400	445	7800	470
500	7.0 – 9.5	7700	455	8100	475	8500	495
550	7.5 – 10.0	8350	490	8800	510	9300	525
600	8.0 – 10.0	9150	520	9650	525	-	-

BW ²⁾	DM-intake ³⁾	Gain (g/day)							
		1300		1400		1500		1600	
(kg)	(kg/day)	VEVI	DVE	VEVI	DVE	VEVI	DVE	VEVI	DVE
100	2.0 – 3.0	-	-	-	-	-	-	-	-
150	2.5 – 4.0	4150	370	-	-	-	-	-	-
200	3.5 – 5.0	4850	395	5100	415	-	-	-	-
250	4.5 – 6.0	5500	410	5750	430	6050	455	-	-
300	5.0 – 7.0	6150	430	6450	450	6750	470	7050	490
350	5.5 – 7.5	6800	445	7100	465	7450	485	7750	505
400	6.0 – 8.0	7450	465	7800	485	8200	505	8550	520
450	6.5 – 8.5	8150	490	8550	505	8950	520	9400	535
500	7.0 – 9.5	8900	515	9350	530	-	-	-	-
550	7.5 – 10.0	9800	535	-	-	-	-	-	-
600	8.0 – 10.0	-	-	-	-	-	-	-	-

- 1) The values for VEVI and DVE (in g) are given per day. The standards matching the desired growth rate from 150 kg BW onward are viewed in **bold**. The animals are ready for slaughter at a body weight of approx. 600 kg.
- 2) BW = body weight
- 3) DM = dry matter

Table 1.17 Feeding standards for beef bulls: late-maturing type (like Piemontese and Blonde d'Aquitaine)¹⁾

BW ²⁾	DM-intake ³⁾	Gain (g/day)					
		1000		1100		1200	
(kg)	(kg/day)	VEVI	DVE	VEVI	DVE	VEVI	DVE
100	2.0 – 3.0	2900	280	3050	300	3250	320
150	2.5 – 4.0	3550	305	3700	330	3900	350
200	3.5 – 5.0	4100	325	4300	350	4500	375
250	4.5 – 6.0	4650	345	4900	370	5100	395
300	5.0 – 7.0	5200	365	5400	390	5650	415
350	5.5 – 7.0	5700	385	5900	410	6150	435
400	6.0 – 7.5	6150	405	6450	430	6700	460
450	6.5 – 8.0	6650	425	6950	455	7200	480
500	7.0 – 8.5	7150	450	7450	480	7750	505
550	7.5 – 9.5	7650	480	7950	510	8300	535
600	8.0 – 10.0	8150	510	8500	540	8850	565
650	8.0 – 10.5	8700	540	9100	570	9500	595
700	8.0 – 11.0	9350	570	9750	595	-	-
750	8.5 – 11.5	10100	575	10600	590	-	-

BW ²⁾	DM-intake ³⁾	Gain (g/day)							
		1300		1400		1500		1600	
(kg)	(kg/day)	VEVI	DVE	VEVI	DVE	VEVI	DVE	VEVI	DVE
100	2.0 – 3.0	-	-	-	-	-	-	-	-
150	2.5 – 4.0	4100	375	-	-	-	-	-	-
200	3.5 – 5.0	4750	400	4950	420	-	-	-	-
250	4.5 – 6.0	5300	420	5550	445	5800	465	-	-
300	5.0 – 7.0	5900	440	6100	465	6400	490	6650	510
350	5.5 – 7.0	6450	460	6700	485	6950	510	7250	535
400	6.0 – 7.5	6950	485	7250	510	7550	530	7850	555
450	6.5 – 8.0	7500	505	7800	530	8100	555	8550	580
500	7.0 – 8.5	8050	535	8400	560	8700	580	9050	605
550	7.5 – 9.5	8600	560	9000	585	9350	610	-	-
600	8.0 – 10.0	9250	590	9600	615	-	-	-	-
650	8.0 – 10.5	-	-	-	-	-	-	-	-
700	8.0 – 11.0	-	-	-	-	-	-	-	-
750	8.5 – 11.5	-	-	-	-	-	-	-	-

1) The values for VEVI and DVE (in g) are given per day. Bull calves of late maturing types usually suckle at their dam until they reach body weights of 250 to 300 kg. From 250 kg BW onward the standards for the desired growth rate are viewed in **bold**. The animals are ready for slaughter at a body weight of approx. 650 to 700 kg.

2) BW = body weight

3) DM = dry matter

1.5.2 Double-muscléd type

Pure-bred double-muscléd beef bulls, such as the double-muscléd types of the Belgian White-blue and Dutch Red-and-White require more protein, according to Belgian studies. Bulls between 350 and 500 kg (BW) need 25% more DVE compared to the late maturing type at a similar growth rate. Between 500 and 700 kg BW the difference decreases gradually to 10%.

The energy requirement also appears to be higher: app. 10% more VEV is needed compared to the late maturing type. This higher energy requirement is probably related to the high stress sensitivity of double-muscléd types.

For cross-breeds of double-muscléd beef types and other types the standards for the intermediate type or the late maturing type may be applied, depending on the degree of muscling.

1.5.3 Fattening of dairy cattle

Table 1.18 Standards for fattening of dairy cattle.

	BW (kg)	Gain (g/day)	VEV (per day)	DVE (g/day)
Dry	550	1000	10000	260
	600	1000	10300	265
	650	1000	10600	270
In milk (12 kg fat standardized milk/day)	550	700	13000	840
	600	700	13300	845
	650	700	13600	850

Increasing the daily feed intake up to the standards given above should occur gradually. For each 50 kg above or below 650 kg the standard should be increased or decreased with 320 VEV and 5 g DVE per day respectively. For lactating cows the standards should be increased or decreased by app. 460 VEV and 52 g DVE for each kg of milk more or less respectively.

1.5.4 Allowance of a OEB shortage

For beef cattle, as for dairy cattle, it is advised to keep the OEB slightly positive (preferably as close to zero as possible). With a DVE supply above the standard (see Table 1.13 to 1.15), a limited negative OEB is allowed for beef cattle from 250 kg BW onward. The following equation applies:

$$\text{Acceptable OEB deficiency (g per animal per day)} = (\text{BW} - 250) \times 0.25$$

BW = body weight in kg

This implies that the OEB shortage that is allowed, may increase from 0 g OEB at 250 kg BW to -100 g OEB at 650 kg BW. A **negative** OEB of the diet means that the DVE supply decreases by OEB x 0.65. Above-mentioned equation for acceptable OEB shortage may only be applied if the **calculated DVE intake - (OEB_{deficiency} x 0.65) is larger than the DVE standard.**

2. Sheep

2.1 Maintenance requirement

The maintenance requirement of VEM and DVE can be calculated by means of the following equations:

- **VEM_{maintenance} (per day) = 30 x BW^{0.75}**
- **DVE_(maintenance, including wool growth) (g/day) = 1.5 x BW^{0.75}**

BW = body weight in kg

2.2 Standards for ewes

2.2.1 Pregnant and lactating ewes

Table 2.1 Standards for animals kept indoors¹⁾

Animal Category		BW (kg)	DM-intake (kg)	VEM	DVE (g)
Pregnant ewes²⁾:					
first 2.5 month of gestation		50	0.9 – 1.5	570	37
		60	1.0 – 1.6	650	41
		70	1.1 – 1.7	730	45
		80	1.2 – 1.9	810	49
		90	1.3 – 2.1	890	53
		100	1.4 – 2.3	960	57
Last 2 months of gestation		60	1.1 – 1.6	1010	110
		70	1.2 – 1.7	1130	114
		80	1.3 – 1.9	1250	117
		90	1.4 – 2.1	1370	121
		100	1.5 – 2.3	1500	125
		110	1.6 – 2.4	1620	128
Nursing ewes³⁾:					
1 lamb	1 st month	65 - 90	2.1 – 2.7	1920	165
	2 nd month		2.0 – 2.5	1780	140
	3 rd month		1.7 – 2.2	1520	115
2 lambs	1 st month		2.5 – 3.3	2460	250
	2 nd month		2.3 – 3.0	2190	210
	3 rd month		1.9 – 2.5	1720	165
3 lambs	1 st month		2.7 – 3.6	2660	280
	2 nd month		2.5 – 3.2	2340	235
	3 rd month		2.0 – 2.6	1860	185

¹⁾ The values for VEM and DVE (in g) are given per day. In pasture, the VEM requirement for maintenance (30 x BW^{0.75}) should be increased by 15%.

²⁾ These standards apply to twin pregnancy of ewes lambing at the age of two years or more. For ewes with single pregnancies the standards for the last two months are

app. 150 VEM and 35 g DVE lower than for twin pregnancies. For triple pregnancies, app. 100 VEM and 15 g DVE more is needed than for twin pregnancies. Younger ewes require an additional allowance (see paragraph 2.2.2).

- 3) These standards apply to ewes of two years of age or older. For the DVE standard for a ewe with two suckling lambs during lactation, a milk protein production is assumed of 135, 110, and 82 gram protein per day for the 1st, 2nd, and 3rd month of lactation respectively. A ewe with one lamb produces 40% less than an ewe with two lambs and an ewe with three lambs produces 15% more. For the synthesis of milk protein an efficiency of 64% is assumed.

The VEM requirement may be expressed also with the next equations:

Table 2.2 Equations for calculating the daily VEM requirements of ewes.

	indoors	grazing
Non-pregnant ewes	7.5 BW + 170	8.5 BW + 210
First 2.5 months of gestation	8.0 BW + 170	9.0 BW + 210
Last 2 months of gestation, 1 lamb	10.5 BW + 270	12.0 BW + 270
Last 2 months of gestation, 2 lambs	12.5 BW + 250	13.5 BW + 300

The standards in Table 2.1 reflect average values, which should be regarded as guidelines. The increase in body weight during gestation may vary strongly between animals. To determine the amount of VEM to be offered, one should pay attention to the body condition (handling the sheep, especially back and loins).

2.2.2 Young ewes (up to approximately 1.5 years)

Ewes lambing at the age of 1 year, should receive an additional allowance in the first 2.5 months of gestation compared to 2-year old ewes, to account for growth to adult body weight. The last two months of gestation young ewes (then weighing approx. 60 kg) only need an extra allowance for gestation. The standards for young ewes are given in Table 2.3.

For young ewes with single pregnancies, it is strongly recommended not to exceed the lower requirement of 910 VEM. If this does happen, the risk of problems around birth increases strongly.

Table 2.3 VEM and DVE standards (per day) for pregnant, young ewes (BW at service 45 to 50 kg) kept indoors¹⁾

	VEM	DVE (g)
First 2.5 months of gestation	670 – 770	65 – 70
Last 2 months of gestation, 1 lamb	910	80
Last 2 months of gestation, 2 lambs	1010	110

- ¹⁾ In pasture, the VEM requirement for maintenance ($= 30 \times \text{BW}^{0.75}$) should be increased by 15%.

Ewes that lamb at the age of 1 year, should - after lambing - receive an additional 100 to 200 VEM and 5 g DVE per day to account for growth.

From weaning to service (at an age of app. 1.5 years), an additional youth allowance is needed of app. 200 VEM and 20 g DVE.

2.3 Standards for fattening lambs

Table 2.4 gives standards for male lambs. These standards should be regarded as guidelines.

Female lambs grow fat faster than male lambs. Female lambs should not be fattened heavier than 40 to 50 kg live weight (depending on feeding level and breed), because otherwise they will become too fat. To obtain the same growth as male lambs, female lambs need app. 10% more VEVI and approx. 5% less DVE.

The diet for fattening lambs should have a structure value of at least 0.75 SW per kg DM. When roughages and concentrates are given simultaneously, this value may decline to 0.60 per kg DM (for more information on structure value, see paragraph 1.3.1).

Table 2.4 Standards for male lambs, fattened indoors¹⁾

BW (kg)	DM-intake (kg/day)	Gain (g/day)							
		200		250		300		350	
		VEVI	DVE	VEVI	DVE	VEVI	DVE	VEVI	DVE
15	0.4 – 0.7	560	65	670	80	790	95	940	106
20	0.5 – 0.9	680	73	810	87	960	102	1140	116
25	0.6 – 1.1	800	79	950	92	1130	107	1340	123
30	0.8 – 1.3	920	83	1090	97	1290	113	1530	130
35	1.0 – 1.5	1030	86	1220	102	1450	119	1750	136
40	1.2 – 1.8	1140	90	1350	106	1610	125	1910	141
50	1.4 – 2.0	1360	91	1610	107	1920	126	-	-

¹⁾ The values for VEVI and DVE (in g) are given per day.

While grazing, the energy requirement will be 60 to 100 VEVI higher.

2.4 Requirements of minerals and trace elements for sheep

For the mineral and trace elements requirements of the different sheep categories see "Handleiding Mineralenvoorziening Rundvee, Schapen, Geiten" (2005).

3. Goats

3.1 Energy and protein requirements for goats

The VEM requirement (per day) for maintenance and milk production for dairy goats can be calculated using the following equations:

- VEM = (36.4 x BW^{0.75} + 442 x FCM) x {1 + (FCM - 2.75) x 0.0009}**

In which:

BW = body weight in kg;
FCM = milk corrected to standard milk with 4% of fat

For a dairy goat weighing 70 kg the VEM requirement can be estimated by the following simplified equation:

- VEM_{maintenance + production} = 879 + 443 x FCM (VEM per day)**

The DVE requirement for maintenance and milk production of dairy goats is calculated in a similar manner as for dairy cattle.

Table 3.1 Standards for the nutrient requirement of lactating goats kept indoors. Body weight: 70 kg. Units: VEM per day, DVE in g/day and milk in kg/day. The maintenance requirement is included in these standards. When grazing day and night, the standard for maintenance should be increased by approx. 20%.

Fat %	3.50		3.75		4.00		4.25		4.50	
Protein %	3.00		3.15		3.30		3.45		3.60	
kg milk	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE	VEM	DVE
2	1700	120	1730	125	1760	130	1800	135	1830	140
4	2520	215	2590	225	2650	235	2720	240	2790	250
6	3340	310	3440	320	3540	335	3640	350	3740	365
8	4170	400	4300	420	4440	440	4570	460	4710	475

Table 3.2 Standards for non-lactating goats kept indoors¹⁾

Animal category	BW ²⁾ (kg)	VEM	DVE (g)
Adult goats ³⁾ :			
maintenance	70	900	27
Dry and last stage of gestation	75	1350	79
Young goats, gestation ³⁾ :			
- 10 months of age	55	1170	50
- 12 months of age	60	1300	80
One-year old goats			
- additional allowance for youth ⁴⁾	-	200	15
Mating billy-goats:			
adult	80	1320 ⁵⁾	35 ⁵⁾
young, 10 to 12 months of age	60	1160 ⁵⁾	27 ⁵⁾

- 1) The values for VEM and DVE (in g) are expressed per day. While grazing, an additional VEM allowance for maintenance of 15% is needed.
- 2) BW = body weight in kg. For each 10 kg BW more or less, the energy requirement changes by 100 VEM and the protein requirement by 3 g DVE per day.
- 3) During the first 2.5 months of gestation, an additional allowance of 5 g DVE per day is required.
- 4) This extra allowance is sufficient for a weight gain of approx. 15 kg during the first lactation.
- 5) Outside the breeding season, these standards may be decreased by approx. 15%.

3.2 Dry matter intake goats

The maximum DM intake from roughages plus concentrates is - depending on the body weight, body condition, and production level of the goat - approx. 4 to 5% of the body weight. The DM intake of roughage alone is, depending on the quality, not higher than approx. 2.5 to 3% of the body weight.

3.3 Requirements of minerals and micro-elements for goats

For the mineral and trace elements requirements of the different sheep categories see "Handleiding Mineralenvoorziening Rundvee, Schapen, Geiten" (2005).

4. Feed ingredients

4.1 General explanation

The contents presented in the tables in the next paragraphs, are (with the exception of those for fresh grass and grass silage in table 2.4) mean values calculated from the data of analyses in the CVB database. The chemical contents and nutritional values are expressed on product base. The chemical analyses en nutritional values for roughages are expressed on dry mater basis (with the exception of the DM content).

For more information on the analysis methods used, the contents of other chemical parameters, the contents of digestible nutrients and the calculation of the feeding values the reader is referred to the 2016-edition of the CVB Table.

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

It should be realized that the dry matter content in roughages (unless dried) may vary considerable.

As the values for fresh and ensiled products are based on different batches, these data cannot be used for the calculation of losses caused by the ensiling process.

For the m³ weights of the different roughages you are referred to the "Handboek Melkveehouderij 2016/2017" Published by Animal Sciences Group of Wageningen UR and Roodbont Publisher (ISBN: 978-90-8740-049-1)

4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutriënts and nutritional values in g/kg product)																		
	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Alfalfa meal CP < 140 g/kg	915	88	101	19	296	11	28	16.2	2.4	18	9.1	625	597	414	47	-23	0.54	0.36
Alfalfa meal CP >180 g/kg	903	115	189	30	233	11	26	30.3	2.7	29.3	15.4	695	687	435	83	38	0.48	0.34
Alfalfa meal CP 140-160 g/kg	911	102	152	22	292	11	26	24.3	2.6	26	15.4	611	579	410	65	12	0.54	0.36
Alfalfa meal CP 160-180 g/kg	910	109	168	25	271	11	35	26.9	3.1	27.3	16.4	638	614	423	73	22	0.51	0.36
Barley	867	20	100	18	43	528	23	16	3.1	4.9	0.5	982	1074	629	101	-59	-0.08	0.25
Barley feed, high grade	884	55	133	45	108	234	50	21.2	6.3	8	1.7	853	891	497	75	-2	0.16	0.27
Barley mill by-product	886	64	118	38	138	202	23	18.8	4.1	7.7	2.6	754	765	456	61	-3	0.24	0.29
Bread (remains)	897	29	121	53	11	506	69	19.4	1.9	2.5	0.8	1137	1266	689	108	-51	-0.22	0.26
Brewers' grains, dried	915	46	248	67	132	40	9	39.6	4.6	0.5	3.5	821	823	324	139	58	0.37	0.29
Brewers' yeast, dried	925	65	459	26	22	62	25	73.4	10.6	19.5	2	905	930	401	227	126	0.24	0.27
Carob pods	897	30	42	8	67	-	421	6.7	0.5	8.3	4	785	819	618	61	-79	-0.12	0.26
Casein	916	32	872	11	-	-	-	139.5	5.3	1.2	1.8	1176	1245	743	163	664	0.29	0.26
Chicory pulp, dried	894	76	84	16	199	6	84	13.4	1.4	5.7	11.4	900	966	565	89	-63	0.38	0.32
Citrus pulp	914	64	63	21	121	10	204	10.1	1	9.4	15.4	974	1063	633	80	-71	0.17	0.29
Coconut expeller CFAT < 100 g/kg	907	61	204	85	113	11	100	32.6	5.5	21.2	0.8	1066	1152	424	158	-5	0.28	0.28
Coconut expeller CFAT > 100 g/kg	941	63	210	122	127	9	75	33.6	5.4	21.1	1	1191	1297	413	161	0	0.33	0.3
Coconut, extracted	910	69	227	23	129	20	77	36.3	5.7	21	1.5	904	952	455	174	-1	0.31	0.29
Cottonseed with hulls. CF > 100 g/kg	911	40	207	192	236	-	29	33.1	6.8	11.1	1.4	1138	1202	334	61	98	0.49	0.34
Cottonseed dehulled. CF < 100 g/kg	935	44	403	308	28	-	41	64.5	7.5	9.4	1.2	1682	1883	374	121	235	0.28	0.27
Cottonseed, expeller partly dehulled CF 140-210 g/kg	933	60	363	74	170	11	38	58.1	10.2	14.4	2.2	919	934	383	159	142	0.41	0.31
Cottonseed, expeller with hulls CF > 210 g/kg	921	51	307	61	230	11	39	49.1	10.3	14.5	2.3	827	821	375	133	111	0.47	0.34
Cottonseed, expeller dehulled CF 55 - 140 g/kg	932	63	416	105	129	11	39	66.5	11.2	14.7	2.4	1036	1077	379	181	172	0.37	0.29
Cottonseed, extracted partly dehulled CF 140-200 g/kg	896	63	364	25	166	20	45	58.2	10.2	15.2	2	763	754	448	118	187	0.38	0.3

4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutriënts and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Cottonseed, extracted with hulls CF > 200 g/kg	945	50	296	38	217	21	37	47.3	10.8	16	2.1	800	789	444	96	139	0.45	0.34
Cottonseed, extracted, dehulled; CF 70 - 140 g/kg	898	65	437	31	120	20	28	69.8	10.7	15.7	2.2	826	829	461	139	238	0.36	0.28
DDGS, Maize	903	44	265	132	63	29	15	42.3	8.1	10.8	-	1190	1296	356	198	24	0.31	0.26
DDGS, Wheat	916	46	324	68	71	11	49	51.8	8.4	-	-	1071	1146	416	202	77	0.3	0.27
Fat/oil, Animal fat	994	1	-	993	-	-	-	-	-	0.2	-	3264	3843	-	-7	-	0.32	0.29
Fat/oil, Vegetable	995	-	-	995	-	-	-	-	-	-	-	3514	4191	-	-4	-	0.32	0.29
Feed beans (Phaseolus). heat treated	862	52	229	16	45	326	40	36.7	4.6	15.2	1.6	977	1064	561	136	39	0.1	0.25
Grass meal CP 45 - 140 g/kg	929	108	122	25	235	13	122	19.6	3.2	24.1	5.3	693	686	442	65	-17	0.38	0.34
Grass meal CP > 200 g/kg	917	126	208	40	201	13	88	33.3	4.1	31.5	5.3	828	858	439	105	39	0.38	0.32
Grass meal CP 140 - 160 g/kg	928	123	151	32	212	13	106	24.2	3.8	27.3	5.3	692	685	434	72	1	0.37	0.33
Grass meal CP 160 - 200 g/kg	929	121	177	38	211	13	90	28.3	4	29.1	5.3	837	869	436	93	17	0.39	0.33
Grass seed	863	47	107	11	104	427	13	17.1	-	-	-	617	600	538	72	-39	0.07	0.27
Groundnut expeller, partly with shell, CF 75 - 145 g/kg	920	51	423	87	95	61	92	67.7	4.7	9.8	2.2	1139	1220	535	152	226	0.24	0.28
Groundnut expeller, with shell, CF > 145 g/kg	933	41	346	97	157	62	93	55.4	4.8	9.9	2.3	1096	1159	482	124	176	0.3	0.31
Groundnut expeller, without shell, CF 30 - 75 g/kg	932	64	476	81	61	62	93	76.2	4.8	9.9	2.3	1176	1267	570	171	260	0.21	0.27
Groundnut extracted, partly with shell, CF 75-145 g/kg	926	56	529	9	116	61	76	84.6	6.5	12.7	1.8	950	980	582	183	297	0.28	0.29
Groundnut extracted, without shell, CF 30 - 75 g/kg	913	60	456	12	64	60	75	73	6.4	12.5	1.8	981	1034	588	167	241	0.23	0.26
Groundnuts, with shell, CF > 85 g/kg	942	28	245	353	174	62	30	39.2	4.2	13	1.5	1718	1920	324	71	127	0.39	0.32
Groundnuts, without shell, CF < 85 g/kg	932	22	287	490	23	62	30	45.9	4.4	5.4	1	2279	2649	313	88	162	0.24	0.27
Hemp seed	913	48	195	316	169	-	-	31.3	8.1	-	1.5	1283	1365	168	44	103	0.46	0.31
Horse beans	870	33	251	12	78	329	28	40.1	5.4	12.2	1	1020	1111	628	113	87	0.16	0.26
Horse beans, white	880	35	286	14	80	341	40	45.8	5.2	13.4	1.5	1035	1124	636	119	117	0.15	0.26

4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutriënts and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Lentils	873	30	230	13	45	413	48	36.8	3.8	9.4	0.8	1009	1098	607	101	77	0.07	0.25
Linseed	917	42	217	349	73	14	23	34.7	5	7.5	2.7	1671	1878	342	71	104	0.33	0.27
Linseed expeller	916	54	331	109	85	27	42	53	8.2	11.8	3.5	1103	1177	454	153	121	0.3	0.27
Linseed, extracted	872	55	320	30	96	35	43	51.1	8.4	10.9	3.1	864	895	476	150	110	0.29	0.27
Lupines CP < 335 g/kg	908	28	314	51	154	12	53	50.3	2.9	7.8	2.4	1150	1250	573	128	143	0.37	0.3
Lupines CP > 335 g/kg	878	39	362	46	138	21	48	57.9	3.5	8.1	2.3	1100	1192	549	136	184	0.34	0.28
Maize	867	12	76	36	20	620	13	12.2	2.4	3.4	0.1	1096	1225	486	99	-67	0.14	0.25
Maize bran	873	14	94	34	99	289	17	15.1	4.6	-	0.3	919	979	528	92	-53	0.22	0.27
Maize feed flour	875	6	76	12	8	685	10	12.1	0.7	1.2	0.2	1092	1224	617	107	-85	-0.05	0.25
Maize feed meal	880	23	91	72	40	455	23	14.5	4	4.6	1.3	1131	1257	504	95	-53	0.08	0.25
Maize feed meal, extracted	867	13	86	33	26	489	26	13.8	3.9	6.2	0.5	1076	1198	568	103	-68	0.04	0.25
Maize germ, extracted	878	34	199	26	74	269	3	31.8	5.2	4.5	0.5	954	1023	502	147	-7	0.22	0.26
Maize germ meal feed expeller	896	44	134	56	59	334	51	21.4	8.3	9	1	1065	1168	515	115	-35	0.13	0.26
Maize germ meal feed, extracted	875	39	138	24	63	325	10	22.1	5.7	7.2	0.9	963	1044	525	121	-39	0.18	0.25
Maize gluten meal	895	15	599	56	10	176	1	95.8	4.3	1.4	0.3	1207	1302	324	445	98	0.17	0.26
Maize gluten feed CP > 230 g/kg	889	62	240	41	74	97	26	38.4	9.5	11.2	2	961	1027	528	90	103	0.28	0.26
Maize gluten feed CP 110 - 200 g/kg	888	57	188	35	73	145	23	30.1	9.5	12.4	0.7	960	1032	536	95	45	0.26	0.26
Maize gluten feed CP 200 - 230 g/kg	895	59	203	40	73	122	24	32.4	9.6	12.1	1.6	975	1047	530	91	64	0.27	0.26
Maize starch	892	1	6	5	2	851	-	1	0.4	-	-	1164	1327	678	85	-131	-0.11	0.26
Maize, distillers' solubles, dried	894	50	260	98	71	54	18	41.6	8	11	1.1	1085	1170	471	170	29	0.3	0.26
Maize, heat treated	882	13	84	42	21	614	15	13.4	3	3.5	0.3	1127	1260	675	138	-117	-0.25	0.25
Malt culms CP < 200 g/kg	921	55	185	20	144	104	95	29.5	4.8	12.6	1.8	718	708	502	61	62	0.35	0.3
Malt culms CP > 200 g/kg	918	56	220	20	131	105	97	35.2	5.8	12.6	1.8	862	893	516	76	87	0.3	0.29
Milk powder, skimmed	951	79	356	10	-	-	489	57	10.2	16.5	12.6	1113	1224	773	143	156	-0.24	0.27
Milk powder, whole	949	59	267	243	-	-	367	42.8	7.6	12.4	9.4	1690	1940	580	107	117	-0.11	0.27
Millet	881	32	111	40	99	497	8	17.8	2.8	3	0.1	904	958	496	99	-52	0.16	0.27

4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutriënts and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Millet, Bulrush	912	25	122	45	20	606	14	19.5	3.3	3.5	0.2	1065	1165	554	118	-62	0.04	0.26
Molasses, sugar beet	758	80	101	2	-	-	477	16.1	0.8	38	1.3	786	868	647	58	-7	-0.29	0.22
Molasses, sugarcane SUG > 475 g/kg	724	91	35	-	-	-	485	5.6	0.7	27.5	6.8	639	691	607	52	-67	-0.31	0.21
Molasses, sugarcane SUG 370 - 475 g/kg	729	111	49	1	1	-	451	7.8	0.7	40.5	7.8	616	661	590	49	-50	-0.27	0.21
Niger seed	916	47	203	409	145	8	35	32.5	6.9	8.2	4	1697	1893	185	61	100	0.39	0.3
Oats	878	25	102	40	106	380	10	16.4	3.2	4.3	0.7	908	964	582	73	-27	0.08	0.27
Oats husk meal	910	42	48	18	268	182	11	7.7	1.4	4.5	2.3	555	509	414	24	-37	0.4	0.35
Oats mill feed. high grade	886	24	91	44	118	269	10	14.6	3.6	-	0.7	903	954	540	63	-26	0.18	0.28
Oats, peeled	887	19	132	66	16	545	14	21	4.3	4	0.6	1188	1330	673	101	-25	-0.13	0.25
Palm kernel expeller CF > 180 g/kg	918	43	150	79	195	2	15	24	5.7	6.7	2.9	974	1024	368	109	-18	0.47	0.32
Palm kernel expeller CF 90 - 180 g/kg	915	44	155	76	167	4	15	24.8	5.8	6.7	2.9	1017	1085	383	116	-19	0.44	0.31
Palm kernel, extracted CF < 210 g/kg DM	893	39	158	24	173	2	12	25.3	6	7.1	2.8	871	909	410	120	-21	0.44	0.3
Palm kernel, extracted CF > 210 g/kg DM	876	40	150	16	204	2	12	23.9	5.9	6.9	2.7	761	771	389	110	-21	0.47	0.31
Palm kernels	938	20	92	480	97	2	15	14.6	3.1	-	1.2	2141	2479	203	58	2	0.38	0.28
Peas	866	28	203	10	54	416	44	32.4	3.7	9.9	0.9	1023	1123	629	105	51	0.09	0.25
Potato chips	962	35	59	300	11	444	28	9.4	1.4	11.2	0.3	1608	1817	528	77	-70	0.29	0.53
Potato protein ASH< 10 g/kg	908	6	795	11	7	5	9	127.2	1.6	0.2	0.4	1096	1142	367	469	251	0.28	0.26
Potato protein ASH> 10 g/kg	904	20	785	31	8	1	9	125.7	2	6.6	0.5	1109	1159	343	460	251	0.29	0.26
Potato pulp. dried CP 20 - 90 g/kg	876	47	61	2	164	251	12	9.7	1	12.7	2.7	863	922	571	80	-79	0.29	0.3
Potato pulp. dried CP 90 – 130 g/kg	880	69	96	4	151	244	12	15.4	1.3	25.1	2.6	848	903	561	91	-58	0.29	0.29
Potato starch, dried	863	5	6	1	4	703	-	0.9	0.7	0.9	0.3	1092	1241	628	74	-118	-0.01	0.25
Potatoes, dried	897	42	93	4	25	599	31	14.9	2.4	12.1	0.5	953	1040	592	89	-52	0.08	0.26
Rape seed, extracted, rumen bypass (MervoBest rape)	878	66	337	30	129	10	93	53.9	11	13	7.2	833	853	318	262	4	0.29	0.28
Rapeseed	924	39	198	416	100	15	56	31.7	6.3	7.4	4.1	1872	2128	279	38	108	0.32	0.28
Rapeseed expeller	904	62	316	99	121	7	75	50.5	10.2	11.4	6.9	1053	1119	450	119	134	0.32	0.28

4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutriënts and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Rapeseed, extracted, CP 290 - 370 g/kg	889	67	344	32	121	8	83	55.1	10.5	12.8	7.8	879	910	482	129	147	0.3	0.28
Rapeseed, extracted, CP > 370 g/kg	906	84	388	16	115	11	89	62	10.7	12.6	7.2	853	876	499	143	174	0.29	0.28
Rice bran, extracted	901	108	143	15	113	270	26	22.8	16.5	12.3	1.1	717	729	462	62	18	0.16	0.28
Rice feed meal, ASH < 90 g/kg	897	73	139	147	55	304	41	22.2	14.2	9.9	4.1	1093	1185	498	75	8	0.06	0.26
Rice feed meal, ASH > 90 g/kg	911	124	137	168	55	234	35	21.9	17.4	10	26.7	1077	1167	436	64	19	0.13	0.26
Rice milling byproducts	912	152	68	52	265	127	9	10.9	11	9.4	3.6	434	372	268	5	2	0.45	0.35
Rice, crude with hulls	886	44	73	19	102	463	13	11.6	2.6	3.4	0.4	825	865	554	66	-54	0.01	0.27
Rice, crude without hulls	885	7	78	8	7	715	9	12.5	0.9	0.9	0.1	1078	1204	740	105	-90	-0.27	0.25
Rye	870	16	97	13	21	514	59	15.5	3.1	4.6	0.4	1007	1110	698	97	-61	-0.16	0.25
Safflower seed	907	28	122	273	340	-	17	19.6	-	-	-	997	996	256	9	57	0.61	0.36
Sesame seed	942	75	220	429	43	-	14	35.3	5.6	5.2	11	1906	2177	257	54	130	0.33	0.27
Sesame seed, expeller	943	132	451	115	62	-	25	72.2	9.8	9.4	19.1	1148	1237	420	174	224	0.34	0.27
Sesame seed, extracted	893	60	430	16	117	-	63	68.8	12.9	10.4	23	910	943	498	177	196	0.33	0.28
Sorghum	872	15	87	28	23	606	8	13.9	2.7	3.5	0.3	1008	1107	467	90	-56	0.17	0.25
Sorghum gluten meal	900	32	430	54	36	246	-	68.8	3	-	-	1138	1231	444	245	99	0.17	0.26
Soya bean hulls CF > 360 g/kg	887	44	100	15	365	6	11	16.1	1.1	12.4	4.9	888	931	452	71	-21	0.62	0.35
Soya bean hulls CF 220 - 320 g/kg	883	48	129	28	306	9	17	20.6	1.7	15.2	5.8	933	990	445	79	-2	0.55	0.35
Soya bean hulls CF 320 - 360 g/kg	882	46	108	20	337	7	16	17.3	1.2	12.8	5.4	901	950	449	73	-16	0.58	0.35
Soya beans, extracted, rumen bypass (Mervobest Soy)	874	60	454	17	60	8	95	72.6	5.7	21.3	2.9	995	1062	362	371	32	0.15	0.25
Soya beans, extracted, rumen bypass, (Rumi S)	873	64	468	17	36	6	103	74.9	6.5	21.7	2.6	996	1064	351	380	33	0.14	0.25
Soya beans, heat treated	897	49	363	197	58	6	70	58.1	5	16.7	2.2	1419	1577	455	156	158	0.18	0.26
Soya beans, raw	897	49	363	196	58	6	70	58.1	5	16.7	2.2	1417	1574	506	107	209	0.18	0.26
Soya expeller	888	61	438	81	60	8	82	70.1	6.1	21	2.7	1179	1286	497	223	179	0.17	0.26
Soya, extracted HiPro CF <45 g/kg CP < 480 g/kg	887	64	468	16	38	11	99	74.9	6.8	22.2	3.1	1027	1103	546	238	189	0.12	0.25

4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutriënts and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Soya, extracted HiPro CF <45 g/kg CP > 480 g/kg	872	65	485	19	37	8	103	77.6	6.4	21.8	3	1014	1087	530	243	202	0.11	0.25
Soya, extracted, CF > 70 g/kg	871	63	417	16	76	12	84	66.7	5.9	21.8	3	994	1066	523	214	163	0.18	0.26
Soya, extracted, CF 45-70 g/kg, CP < 450 g/kg	877	61	426	22	60	9	91	68.2	6.6	21.9	3.1	1018	1094	531	219	168	0.16	0.25
Soya, extracted, CF 45-70 g/kg, CP > 450 g/kg	877	61	464	16	55	5	90	74.2	6.4	21.9	3.1	1015	1087	533	235	189	0.15	0.25
Sugar	1000	-	-	-	-	-	1053	-	-	-	-	1080	1250	998	111	-174	-0.86	0.29
Sugar beet pulp, dried SUG < 100 g/kg	899	67	73	8	166	7	64	11.7	0.8	5.4	9.9	933	1011	572	89	-72	0.37	0.3
Sugar beet pulp, dried SUG 100 - 150 g/kg	901	67	88	9	168	7	123	14.1	0.7	6.8	9	932	1008	587	93	-61	0.31	0.3
Sugar beet pulp, dried SUG 150 - 200 g/kg	907	77	99	7	137	7	185	15.8	0.7	15.4	8	935	1015	608	94	-53	0.21	0.29
Sugar beet pulp, dried SUG > 200 g/kg	912	76	103	7	130	7	219	16.5	0.8	16.2	7.7	943	1024	623	95	-49	0.17	0.29
Sunflower seed expeller, partly dehulled, CFIBER 200 - 315 g/kg	924	59	287	100	239	4	47	46	7.7	13	2.9	874	875	374	93	137	0.47	0.34
Sunflower seed expeller, with hulls, CFIBER > 315 g/kg	913	56	214	103	372	2	26	34.2	7.6	12.9	2.9	626	564	218	44	113	0.63	0.36
Sunflower seed extracted dehulled CF < 160 g/kg	892	66	382	17	148	8	53	61.1	10.3	14.9	3.5	845	862	485	140	185	0.36	0.29
Sunflower seed extracted partly dehulled, CF 160-200 g/kg	892	67	352	19	178	8	50	56.4	10.3	14.9	3.5	787	789	459	126	169	0.4	0.31
Sunflower seed, dehulled CF < 90 g/kg	940	34	212	450	75	4	32	34	4.4	9.2	2.4	1979	2256	295	58	118	0.34	0.28
Sunflower seed, expeller dehulled, CF 120 - 200 g/kg	930	63	381	73	163	5	60	61	7.7	13.1	2.9	977	1010	471	136	187	0.39	0.31
Sunflower seed, extracted partly dehulled, CF 200-240 g/kg	888	64	308	19	224	8	52	49.3	10.2	14.8	3.5	699	677	418	106	144	0.44	0.33
Sunflower seed, extracted with hulls, CF > 240 g/kg	890	59	270	19	274	8	44	43.2	10.3	14.8	3.5	612	568	367	85	126	0.5	0.35
Sunflower seed, partly dehulled CF 90-200 g/kg	914	30	182	326	165	4	24	29.1	4.3	7.8	2.3	1494	1642	275	43	97	0.43	0.31
Sunflower seed, with hulls CF > 200 g/kg	914	27	140	291	285	4	33	22.4	4.3	7.8	2.3	1177	1226	179	14	80	0.53	0.36
Sweet potatoes, dried	878	38	40	6	27	592	68	6.4	1.3	5.8	1.7	939	1030	720	87	-109	-0.23	0.25

4.2 Ingredients for concentrate of ruminants (VEM, VEVI, SW en VW per kg product; DM and other nutriënts and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Tapioca, dehydr. STAew 550 - 625 g/kg	883	58	23	5	62	593	9	3.6	0.7	6	4.1	894	973	665	72	-109	-0.16	0.26
Tapioca, dehydr. STAew 625 - 675 g/kg	879	58	23	5	53	620	8	3.6	0.7	6.2	2.5	907	993	673	74	-110	-0.19	0.25
Tapioca, dehydr. STAew 675 - 725 g/kg	873	51	23	4	48	653	7	3.7	0.9	6.6	2	917	1006	684	77	-113	-0.22	0.25
Tapioca starch	880	1	11	2	2	855	-	1.8	0.4	-	0.2	1129	1283	794	94	-141	-0.43	0.25
Triticale	870	17	107	13	22	540	31	17.1	3.4	4.8	0.4	1035	1146	704	99	-51	-0.15	0.25
Vinasse, beet CP 145 - 230 g/kg	663	174	214	-	1	-	37	34.2	0.9	70.2	4.1	588	636	450	28	145	0.17	0.19
Vinasse, beet CP> 230 g/kg	695	139	283	2	-	-	34	45.2	1.8	47.6	4	671	721	512	32	205	0.18	0.2
Wheat	858	15	112	14	23	589	27	17.9	2.8	3.8	0.4	1021	1130	691	100	-45	-0.18	0.25
Wheat bran grits	870	48	155	33	106	136	58	24.8	9.8	12.3	1.4	763	777	477	53	47	0.23	0.27
Wheat feed meal	869	44	153	34	69	223	68	24.6	8.2	12.7	1	881	932	548	70	29	0.1	0.25
Wheat feed flour, CF < 35 g/kg	866	23	154	35	24	419	46	24.6	4.7	5.9	0.6	1054	1162	649	93	4	-0.07	0.25
Wheat feed flour, CF > 35 g/kg	867	29	155	38	44	325	65	24.7	6.6	9.9	0.9	985	1069	601	83	16	0	0.25
Wheat germ feed	866	40	179	46	52	245	65	28.6	9.1	10.3	0.9	958	1030	562	78	47	0.07	0.25
Wheat germs	872	41	264	85	35	195	109	42.3	7.9	9.4	0.5	1125	1234	562	95	116	0.05	0.25
Wheat gluten feed ASH < 40 g/kg	887	36	147	38	56	289	92	23.5	6.4	11.1	1	919	978	554	94	-8	0.01	0.25
Wheat gluten feed ASH > 65 g/kg	913	66	155	52	63	189	126	24.9	10.9	11.4	1.1	905	956	517	87	6	0.06	0.26
Wheat gluten feed ASH 40 – 50 9/kg	898	47	158	43	80	196	78	25.3	8.7	11.2	1.1	852	885	492	84	12	0.12	0.27
Wheat gluten feed ASH 50 – 65 g/kg	906	53	160	47	69	184	106	25.6	10	11.4	1.1	891	936	508	88	11	0.09	0.26
Wheat gluten meal	911	9	781	56	5	29	28	124.9	1.8	1.2	0.7	1284	1381	550	269	427	0.24	0.26
Wheat grits	874	41	154	35	85	184	63	24.7	8.8	13.3	0.9	843	879	529	65	35	0.15	0.26
Whey powder	976	80	130	9	-	-	698	20.8	6.2	23.1	5.4	1108	1241	838	111	-43	-0.47	0.28
Whey powder, low lactose ASH < 210 g/kg	956	177	252	53	-	-	467	40.3	14.7	45.3	17.6	1061	1179	663	110	90	-0.22	0.27
Whey powder, low lactose ASH > 210 g/kg	962	230	217	41	-	-	444	34.7	19.6	48.7	33.8	972	1079	631	99	66	-0.19	0.28

- In general, CFAT is analyzed without acid hydrolysis. STA is analyzed with amyloglucosidase.
- The processing of animal products in feeds for ruminants is currently forbidden within the EU.
- The processing of animal meal, greaves meal and meat-and-bone meal in horse feeds is currently forbidden within the EU.

4.3 Wet by-products (DM in g/kg product; VEM, VEVI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg DM)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Brewers' grains, fresh and silage, coarse	257	39	258	103	180	16	24	41.3	5.7	0.6	2.6	948	953	376	146	55	1.00	0.55
Brewers' grains, traditional process, DM 175 – 250 g/kg	222	42	242	105	176	18	4	38.7	6.6	0.5	3.3	942	948	362	135	51	1.00	0.55
Brewers' grains, traditional process, DM > 250 g/kg	266	45	248	109	170	18	5	39.7	6.6	0.6	4.1	955	965	361	139	54	1.00	0.55
Carrot peelings, steamed	53	127	89	23	119	-	20	14.2	4.6	48.2	5.8	1075	1188	546	81	-46	1.10	0.69
Cheese whey, fresh CP < 175 g/kg DM	41	107	150	34	-	-	536	24.0	8.4	26.5	11.5	1161	1302	865	70	21	-0.40	0.30
Cheese whey, fresh CP 175 - 275 g/kg DM	36	115	209	54	-	-	460	33.4	9.6	28.5	12.8	1197	1338	836	64	86	-0.20	0.30
Cheese whey, fresh CP > 275 g/kg DM	31	155	335	56	-	-	199	53.6	13.9	40.3	14.7	1172	1297	781	49	226	-0.10	0.30
Chicory press pulp, fresh and ensiled	228	104	86	12	233	-	49	13.8	1.5	9.0	7.6	975	1044	574	83	-53	1.05	0.70
Corn cob mix (CCM), silage without corncob, CF < 40 g/kg DM	662	16	97	48	23	675	7	15.5	3.0	4.0	0.1	1208	1334	597	82	-43	0.40	0.65
Corn cob mix (CCM), silage with part of corncob, CF 40 - 60 g/kg DM	632	18	94	43	45	613	3	15.0	3.0	4.0	0.1	1176	1292	569	78	-39	0.50	0.66
Corn cob mix (CCM), silage with corncob, CF > 60 g/kg DM	525	21	97	43	72	588	3	15.5	3.0	4.0	0.1	1146	1250	548	75	-34	0.60	0.75
Maize gluten feed, fresh and silage STAew < 200 g/kg DM	414	57	198	38	134	88	17	31.7	9.9	16.3	0.3	1064	1137	516	90	58	0.60	0.55
Maize gluten feed, fresh and silage STAew > 200 g/kg DM	418	39	166	38	86	308	12	26.6	6.8	10.6	0.3	1099	1186	542	107	2	0.60	0.55
Maize solubles	473	177	446	11	4	3	88	71.4	31.7	52.0	0.7	1013	1089	787	44	337	0.10	0.30
Potato fruit-juice, concentrated	548	290	327	-	-	-	57	52.3	11.1	138.5	0.9	896	978	666	57	226	0.10	0.30
Potato pulp, pressed	150	62	109	2	194	225	11	17.4	1.7	29.0	1.2	1019	1095	509	102	-57	0.80	0.55
Potato pulp, pressed, fresh and ensiled (Dutch origine)	161	43	81	2	206	191	11	13.0	0.9	18.0	1.4	1031	1108	566	91	-69	0.80	0.55
Potato cutting, raw	212	31	80	2	26	717	20	12.8	1.7	12.9	0.7	1128	1247	596	84	-59	0.60	0.55
Potato peelings, steamed, STAam < 350 g/kg DM	110	81	156	13	75	282	33	24.9	2.6	30.6	2.1	1082	1183	786	116	-29	0.55	0.45

4.3 Wet by-products (DM in g/kg product; VEM, VEVI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg DM)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Potato peelings, steamed, STAam 350 - 475 g/kg DM	132	68	135	11	53	415	21	21.6	2.5	27.4	1.4	1099	1207	802	120	-56	0.50	0.45
Potato peelings, steamed, STAam 475 - 600 g/kg DM	142	56	115	9	39	535	11	18.3	2.5	24.6	1.0	1112	1225	816	122	-82	0.45	0.45
Potato peelings, steamed, STAam > 600 g/kg DM	150	52	102	9	32	612	10	16.3	2.5	23.6	1.0	1117	1232	820	124	-98	0.40	0.45
Potato starch, untreated, solid	451	19	22	4	14	863	2	3.5	1.1	2.3	0.7	1235	1396	666	88	-124	0.10	0.30
Potato starch, untreated liquid STAam 400-600 g/kg DM	201	66	112	5	43	519	23	17.9	2.6	4.7	2.2	1090	1199	648	85	-31	0.10	0.30
Potato starch, untreated liquid STAam 600 - 750 g/kg DM	268	32	75	3	30	678	22	12.0	2.1	3.3	1.3	1126	1245	683	88	-74	0.00	0.30
Potato starch, untreated liquid STAam > 750 g/kg DM	329	18	46	3	21	780	17	7.4	1.7	2.1	0.8	1233	1390	698	92	-104	-0.10	0.30
Sugar beet pulp, pressed, fresh and ensiled	249	74	84	6	195	9	36	13.5	0.9	3.9	9.5	1060	1154	600	93	-64	1.05	0.70
Wheat yeast concentrate CP < 275 g/kg DM	264	65	262	59	27	16	130	41.9	8.3	14.4	1.8	1187	1298	618	127	83	0.13	0.30
Wheat yeast concentrate CP 275 - 325 g/kg DM	265	68	293	67	20	16	126	46.9	8.2	15.6	1.7	1207	1321	608	136	106	0.11	0.30
Wheat yeast concentrate CP 325 - 425 g/kg DM	268	72	375	63	12	16	129	60.0	12.1	19.0	1.4	1207	1314	617	166	160	0.08	0.30

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEMI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg dry matter)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Alfalfa, artificially dried	903	117	172	23	314	-	47	27.4	2.9	24.4	14.9	671	637	510	73	23	3.94	1.4
Alfalfa, ensiled	403	142	200	24	288	-	25	32.1	3.3	33.1	12.1	678	650	458	38	88	3.06	0.96
Alfalfa, fresh	201	110	210	30	233	-	50	33.6	3	32.8	-	827	834	449	41	88	1.74	0.96
Alfalfa, hay	872	101	175	20	312	-	50	28.1	2.8	27.6	12.9	663	625	450	75	28	3.92	1.4
Apples, fresh	157	23	26	19	65	36	642	4.2	0.7	8.1	0.6	1130	1251	836	95	-135	0.6	0.55
Barley straw	884	72	43	26	423	-	-	6.8	0.9	15.1	3.4	521	450	263	0	-18	4.3	1.66
Bean straw (Phaseolus)	863	113	107	15	380	-	-	17.1	1.7	15.4	13.7	641	602	256	42	4	4.3	1.66
Bean straw (Vicia)	840	73	80	15	470	-	-	12.8	1.7	15.4	13.7	554	487	267	24	-6	4.3	1.66
Beet rests, ensiled	135	185	110	5	147	-	2	17.6	2.2	14.2	12.4	790	824	563	88	-48	1.4	0.69
Beetroot	136	78	91	20	74	-	475	14.6	3.6	34.5	-	1080	1189	721	102	-88	1	0.69
Cabbage (Brussels sprouts)	162	84	227	27	139	-	200	36.3	6.6	27.8	-	1072	1156	610	94	64	1.29	0.9
Cabbage (Brussels sprouts, stem and leaves)	180	110	187	35	180	-	-	29.9	3.7	26.3	-	1007	1074	482	72	51	1.82	0.9
Cabbage (cauliflower)	72	138	295	22	111	-	150	47.2	6	42.5	-	1030	1109	597	95	127	0.92	0.9
Cabbage (marrow stem)	120	130	172	35	180	-	-	27.5	2.5	23	-	981	1045	461	67	42	1.82	0.9
Cabbage (red/white/savoy), fresh	105	116	181	35	163	-	200	28.9	3.7	33	-	1007	1079	561	82	31	1.6	0.9
Cabbage (turnip cabbage), fresh	110	130	134	5	90	-	-	21.4	2	25	-	1013	1107	541	97	-39	1	0.69
Cabbage (winter rape)	100	150	201	35	175	-	-	32.2	2.5	23	-	958	1017	467	71	63	1.76	0.9
Carrots	112	91	82	16	89	-	344	13.2	3.2	27.8	4	1071	1182	678	94	-84	1	0.69
Chicory roots, forced, clean	149	82	51	10	89	-	210	8.2	2.5	21.8	3.3	1026	1122	656	76	-93	1	0.69
Chicory roots, not forced	200	100	65	10	60	-	110	10.4	2.2	18.4	-	1110	1239	610	82	-79	0.8	0.69
Chicory leaves, ensiled	175	341	115	20	141	-	-	18.4	-	-	-	464	434	362	3	43	1.56	1
Chicory leaves, fresh	156	202	189	36	133	-	-	30.2	-	-	-	835	870	426	75	55	0.93	0.92
Clover red, artificially dried	899	116	189	40	239	-	-	30.3	3.3	22.2	14.6	784	779	459	81	37	2.95	0.36
Clover red, ensiled	364	153	196	34	270	-	42	31.3	2.9	38.6	10.6	672	643	523	38	77	2.86	0.93
Clover red, fresh	130	116	208	40	218	-	-	33.3	-	-	-	822	827	472	98	52	1.6	0.98

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEMI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg dry matter)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Clover red, hay	830	100	182	35	344	-	-	29.1	3.1	27.9	-	649	602	417	71	37	4.35	1.4
Cucumber, fresh	58	102	156	20	136	-	391	25	6.1	38.5	38.8	907	953	662	126	-51	1	0.55
Endive, fresh	52	164	290	22	122	-	156	46.4	5.5	74.6	-	954	1015	578	95	123	1	0.92
Field beans (Vicia faba) ensiled	326	87	178	24	292	146	1	28.5	2.7	25.9	15.2	709	681	501	47	52	2.52	0.9
Fodder beet leaves, fresh	115	200	182	20	110	-	-	29.1	2.3	35	-	844	889	434	74	51	0.7	0.92
Fodder beets, fresh	139	95	78	10	59	-	587	12.5	2	22.9	1.4	1056	1169	752	101	-99	1.05	0.69
Gherkin, fresh	49	84	226	21	167	-	335	36.2	-	-	-	905	937	637	154	-18	1	0.55
Grass dehydrated, baled	889	104	153	35	249	-	108	24.5	3.7	33.8	6	902	933	497	81	4	3.09	0.9
Grass hay, a) poor quality	845	89	106	28	334	6	98	17	4.2	34.1	5	747	732	424	40	3	4.21	1.45
Grass hay, b) average quality	845	100	132	28	288	6	98	21.1	4.2	34.1	5	790	789	462	58	8	3.6	1.4
Grass hay, c) good quality	845	109	170	28	244	6	98	27.2	4.2	34.1	5	834	846	499	73	31	3.02	1.35
Grass silage k) Sept./Oct., 3000 kg DM/ha	426	140	201	40	245	-	52	32.2	4.2	34.1	5	845	863	526	59	77	2.86	1
Grass silage, a) May, 2000 kg DM/ha	453	118	232	40	224	-	77	37.2	4.2	34.1	5	939	980	575	73	98	2.6	0.96
Grass silage, b) May, 3500 kg DM/ha	453	112	192	40	260	-	77	30.8	4.2	34.1	5	894	920	539	65	62	3.05	1.02
Grass silage, c) May 5000 kg DM/ha	453	110	163	40	290	-	77	26.1	4.2	34.1	5	853	868	509	56	41	3.43	1.08
Grass silage, d) June, 2000 kg DM/ha	486	121	228	40	237	-	93	36.4	4.2	34.1	5	893	920	556	74	89	2.76	0.97
Grass silage, e) June, 3000 kg DM/ha	486	110	189	40	259	-	93	30.2	4.2	34.1	5	884	909	535	67	56	3.04	1.02
Grass silage, f) June, 4000 kg DM/ha	486	104	161	40	278	-	93	25.8	4.2	34.1	5	869	889	517	61	35	3.28	1.06
Grass silage, g) July/Aug, 2000 kg DM/ha	505	129	241	40	233	-	84	38.6	4.2	34.1	5	884	909	548	76	100	2.71	0.96
Grass silage, h) July/Aug. 3000 kg DM/ha	505	118	197	40	255	-	84	31.5	4.2	34.1	5	872	894	524	69	62	2.99	1.01
Grass silage, i) July/Aug. 4000 kg DM/ha	505	112	167	40	272	-	84	26.7	4.2	34.1	5	856	873	507	62	39	3.2	1.05
Grass silage, j) Sept./Oct., 2000 kg DM/ha	426	149	239	40	231	-	52	38.2	4.2	34.1	5	847	865	542	64	110	2.69	0.97
Grass silage, l) average	474	114	192	40	258	-	52	30.8	4.2	34.1	5	888	913	520	65	63	3.03	1.02
Grass, fresh, a) April, early	172	101	206	41	191	-	129	33	4.3	36.6	5.8	1063	1143	571	101	53	1.51	0.89
Grass, fresh, b) April, planned	172	100	227	44	208	-	129	36.3	4.3	36.6	5.8	1043	1112	567	105	68	1.68	0.89
Grass, fresh, c) April, late	172	93	211	42	232	-	129	33.8	4.3	36.6	5.8	1017	1077	562	98	54	1.92	0.89

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEVI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg dry matter)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Grass, fresh, d) May, early	164	103	194	40	211	-	112	31	4.3	36.6	5.8	1028	1097	558	95	44	1.71	0.89
Grass, fresh, e) May, planned	164	99	215	43	230	-	112	34.4	4.3	36.6	5.8	1010	1068	553	98	58	1.9	0.89
Grass, fresh, f) May, late	164	94	192	39	256	-	112	30.7	4.3	36.6	5.8	980	1029	547	90	39	2.16	0.9
Grass, fresh, g) June, early	169	116	249	47	198	-	115	39.8	4.3	36.6	5.8	1030	1095	560	108	88	1.58	0.9
Grass, fresh, h) June, planned	169	103	216	43	228	-	115	34.6	4.3	36.6	5.8	1008	1066	553	98	59	1.88	0.89
Grass, fresh, i) June, late	169	92	172	36	248	-	115	27.5	4.3	36.6	5.8	983	1036	552	85	24	2.08	0.89
Grass, fresh, j) July, early	159	120	225	44	207	-	91	36	4.3	36.6	5.8	1012	1076	546	100	70	1.67	0.9
Grass, fresh, k) July, planned	159	108	226	44	231	-	91	36.2	4.3	36.6	5.8	998	1052	544	99	68	1.91	0.89
Grass, fresh, l) July, late	159	98	196	40	252	-	91	31.4	4.3	36.6	5.8	978	1027	539	89	44	2.12	0.9
Grass, fresh, m) Aug, early	150	122	242	46	225	-	74	38.7	4.3	36.6	5.8	995	1049	542	102	83	1.85	0.9
Grass, fresh, n) Aug, planned	150	111	235	45	234	-	74	37.6	4.3	36.6	5.8	996	1048	547	100	76	1.94	0.89
Grass, fresh, o) Aug, late	150	102	207	41	245	-	74	33.1	4.3	36.6	5.8	989	1040	547	93	53	2.05	0.89
Grass, fresh, p) Sept, early	149	118	254	48	221	-	62	40.6	4.3	36.6	5.8	1005	1060	539	105	94	1.81	0.9
Grass, fresh, q) Sept, planned	149	113	256	48	226	-	62	41	4.3	36.6	5.8	1007	1061	543	106	94	1.86	0.89
Grass, fresh, r) Sept, late	149	104	241	46	232	-	62	38.6	4.3	36.6	5.8	1005	1058	544	102	81	1.92	0.89
Grass, fresh, s) Oct, early	163	113	249	47	211	-	80	39.8	4.3	36.6	5.8	1010	1066	560	106	86	1.71	0.9
Grass, fresh, t) Oct, planned	163	109	252	48	212	-	80	40.3	4.3	36.6	5.8	1014	1071	564	107	88	1.72	0.9
Grass, fresh, u) Oct, late	163	104	247	47	216	-	80	39.5	4.3	36.6	5.8	1013	1069	564	106	83	1.76	0.89
Grass, fresh, v) year average	163	106	227	44	228	-	96	36.3	4.3	36.6	5.8	1006	1062	548	100	69	1.88	0.89
Grass/clover, silage White clover	456	121	167	33	279	-	58	26.7	-	-	-	803	807	572	60	43	3.13	0.97
Grass/clover, silage Red clover	370	114	166	24	303	-	32	26.5	-	-	-	718	697	547	53	46	3.33	0.96
Green cereal plants, fresh	160	80	110	35	250	230	-	17.6	3.9	29	-	913	946	518	62	-17	2.1	0.92
Green cereal plant silage	250	80	107	35	250	207	-	17	3.7	27.3	3.5	932	973	603	46	-2	2.93	1.11
Leek, fresh	100	97	165	24	121	-	400	26.4	3.9	31.7	4.2	970	1034	653	102	-3	0.6	0.92
Lettuce, fresh	61	175	237	45	116	-	100	37.9	5.3	56.2	12.2	966	1032	510	87	86	0.6	0.92
Maize fresh, chopped DM 240 - 280 g/kg	263	51	84	25	195	297	-	13.4	2	12	1.5	908	934	499	50	-24	1.66	0.94

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEMI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg dry matter)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVI	FOMr	DVE	OEB	SW	VW
Maize fresh, chopped DM < 240 g/kg	225	58	94	25	215	224	-	15	2	12	1.5	871	888	485	48	-13	1.84	1.04
Maize fresh, chopped DM 280 - 320 g/kg	300	48	80	25	185	333	-	12.8	2	12	1.5	925	956	502	51	-28	1.57	0.83
Maize fresh, chopped DM > 320 g/kg	336	46	79	25	180	366	-	12.6	2	12	1.5	935	968	501	52	-30	1.52	0.8
Maize silage DM < 240 g/kg	222	57	101	25	244	191	-	16.2	2	12	1.5	832	837	524	43	-5	2.1	1.04
Maize silage DM 240 - 280 g/kg	265	52	95	25	225	245	-	15.2	2	12	1.5	865	879	524	45	-12	1.92	0.95
Maize silage DM 280 - 320 g/kg	301	52	90	25	207	294	-	14.4	2	12	1.5	889	910	524	47	-18	1.77	0.84
Maize silage DM > 320 g/kg	351	47	89	25	191	322	-	14.2	2	12	1.5	918	946	515	47	-19	1.62	0.81
Maize, chopped, dehydrated	909	54	86	25	208	249	-	13.8	2	12	1.5	907	934	451	43	-12	0.52	0.35
Oat straw	840	70	37	17	450	-	-	5.9	1.6	17.9	5.2	531	463	266	-1	-20	4.3	1.66
Onions, fresh	118	134	135	25	115	-	275	21.6	3	16.5	9.4	1055	1160	571	76	-2	1	0.9
Pea leaves, ensiled	227	169	183	26	258	-	-	29.3	3.7	21.1	-	663	640	540	31	75	3.03	1
Pea leaves, fresh	180	93	184	35	274	-	-	29.4	2.7	21.1	-	822	822	474	81	34	2.34	0.92
Pea straw	710	106	106	16	368	-	-	17	1.2	23.3	21.6	523	457	258	31	4	4.3	1.66
Pears, fresh	165	24	16	15	146	-	558	2.6	0.4	1.2	0.8	1098	1205	807	87	-134	0.6	0.55
Potato peelings, ensiled	220	80	98	12	188	485	5	15.7	2.9	27.2	-	1016	1094	560	69	-35	0.75	0.55
Potatoes, fresh	202	57	105	3	41	627	30	16.8	2	22.2	0.6	1097	1207	565	85	-37	0.7	0.65
Potatoes, raw, ensiled	322	74	71	1	33	536	5	11.4	2	11	-	1068	1179	565	69	-57	0.6	0.65
Rapeseed straw	849	70	38	8	523	-	-	6.1	1.1	14.1	15.6	327	232	269	-14	-20	4.3	1.66
Rye straw	840	70	29	16	485	-	-	4.6	1	10	-	482	404	266	-8	-22	4.3	1.66
Spinach, fresh	94	186	256	37	99	-	-	41	6.2	62	9.7	953	1019	479	80	110	1	0.92
Straw, red clover,	830	68	100	24	476	-	-	16	-	-	-	445	357	267	25	1	4.3	1.66
Sugar beet leaves with tops, fresh	160	200	151	20	100	-	-	24.2	2.3	31	-	857	910	418	65	32	0.6	1
Sugar beet leaves, silage	182	313	126	20	137	2	1	20.1	3.1	39.3	13.9	626	634	465	18	44	1.51	1
Sugar beets, fresh	260	190	41	5	45	-	600	6.6	1.6	8	-	931	1033	708	77	-107	0.8	0.69
Sunflower, silage	184	126	119	58	307	-	-	19	3.7	38.2	18	803	805	481	36	25	2.66	1
Sweet pepper, fresh	125	62	163	37	176	-	375	26.1	2.9	-	1.2	864	880	670	125	-50	0.6	0.55

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEVl, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg dry matter)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	N	P	K	Ca	VEM	VEVl	FOMr	DVE	OEB	SW	VW
Tomatoes, fresh	63	90	164	47	96	-	450	26.2	4.9	42	1.9	977	1037	667	132	-49	0.6	0.55
Wheat straw	878	84	41	12	418	-	-	6.6	0.9	14.8	4.3	425	343	264	-5	-18	4.3	1.66
Whole crop silage (cereals)	325	79	122	30	248	130	14	19.5	3	19.4	3.7	794	792	503	38	12	2.51	0.76

- In general, CFAT is analyzed without acid hydrolysis. STA is analyzed with amyloglucosidase.
- For potato-peelings, ensiled, contents can vary widely due to the presence of vegetable waste.
- The average composition of fresh grass, grass silage, maize and whole crop silage (cereal) are based on the NIRS-analyses of Eurofins (previously BLGG AgroXpertus).
- The CP-content is inclusive NH₃; DVE and OEB are calculated using CP inclusive NH₃; whole crop silage, grass silage and green cereal plant silage are calculated with a NH₃-fraction of 10%, for maize silage with 5%.

Grass silage

- 1) The values apply for sandy soil, clay soil and well drained peat soil. For badly drained (dehydrated) peat soil lower feeding values must be taken into account (minus 50 VEM, minus 65 VEVl, minus 35 FOMr minus 5 g DVE and minus 10 g OEB).
- 2) The values roughly match with an N dose according to the fertilizer recommendation of 2002 (Committee recommendation fertilizer).
- 3) The values apply for silages with a DM content of 45%. At lower DM content the SUG content will decline and the NH₃-fraction will increase.
- 4) The values of the middle yield class (in September/October the lowest yield class) match with the average values of Eurofins of all sand and clay soils in the period 2000-2002. The values of the lower and higher yield classes are based on the grass growth model and the ensilage model of Wageningen Livestock Research.
- 5) The CP content is inclusive NH₃. The values presented are based on a NH₃ fraction of 10%.
- 6) DVE and OEB are calculated on the basis of CP inclusive NH₃.
- 7) The values apply for a summer with normal/average rain fall. In case of dry summers one has to account for:
 - A strong reduction in grass growth. Due to the growth retardation the number of growing days, necessary for reaching the DM yields as shown in the table (especially for the highest DM yields) will increase strongly.
 - Slightly higher CFIBER contents (2 to 8 g/kg DM). The increase will be highest at the highest DM yields.

Fresh grass

- 1) The values apply for grass from sandy soil, clay soil and well drained peat soil. For grass from badly drained peat soil lower feeding values must be taken into account (minus 50 VEM, minus 65 VEVI, minus 35 FOM minus 5 g DVE and minus 10 g OEB).
- 2) The values roughly match with a N-gift/dosage according to the fertilizer recommendation of 2002 (Committee recommendation fertilizer)
- 3) The planned value corresponds with the average value of Eurofins for all sand- and clay soils during the period 2000-2002.
- 4) The values for too late and too early are based on calculations executed with the grass growth model of Wageningen Livestock Research.
 - 'Too early' means 7 days earlier than planned.
 - 'Too late' means 7 days later than planned.
- 5) The values apply for a summer with an average rain fall. In case of dry summers one has to account for:
 - A strong reduction in grass growth. Due to the growth retardation the number of growing days, necessary for reaching the DM yields as shown in the table (especially for the category 'too late') will increase strongly.
 - Slightly higher CFIBER contents (2 to 8 g/kg DM) especially in the situation 'too late'.

4.5a Average and limit values of minerals in meadow grass, grass silage and maize silage, corn cob with bracts, (ensiled), whole crop silage (cereals) and green cereal plant silages, destined for animal nutrition for ruminants. ^{1) 2)}

		Minerals						
		g/kg DM						
		P	K	Ca	Mg	Na	Cl	S
Meadow grass	Average	4.1	34.4	5.7	2.4	2.2	-	3.6
	lower value	2.9	21.6	3.8	1.7	<0.5	-	2.1
	upper value	5.1	41.9	8.3	3.6	4.3	-	5.0
Grass silage	Average	4.0	32.8	5.0	2.4	2.6	12.7	3.2
	lower value	3.2	26.2	4.0	1.9	1.2	7.4	2.4
	upper value	4.8	39.6	6.5	3.0	4.2	18.5	4.1
Grass clover silage	Average	3.8	31.7	7.9	2.5	1.6	11.0	2.7
	lower value	2.9	23.6	4.6	1.8	0.6	5.3	1.9
	upper value	4.8	39.6	>11	3.4	3.1	17.0	3.7
Grass hay	Average	2.7	19.3	4.8	1.9	1.8	7.1	2.2
	lower value	1.8	11.4	3.0	1.3	<0.4	-	1.3
	upper value	3.8	28.3	6.8	2.8	3.9	-	3.3
Maize silage	Average ³⁾	2.0	11.3	1.6	1.2	0.2	2.2	1.0
	lower value	1.6	9.6	1.2	1.0	0.1	1.4	0.9
	upper value	2.5	13.8	2.1	1.5	0.4	3.0	1.1
Corn cob with bracts, ensiled	Average	2.6	5.1	0.4	1.1	0.3	0.9	1.0
	lower value	1.9	4.0	<0.4	0.8	0.1	-	0.9
	upper value	3.3	7.6	0.7	1.4	1.2	-	1.2
Whole crop silage (cereals)	Average	3.0	14.1	3.1	1.5	0.5	3.8	1.6
Green cereal plant silage	Average	3.6	28.0	3.5	1.5	0.8	6.4	1.9
Lucerne silage	Average	3.4	29.4	13.8	2.5	1.0	7.0	2.7

¹⁾: The average and the lower and upper limit values are calculated on the basis of Eurofins over the years 2007 until 2011. About 95 % of the contents in the crop analyses are between the lower and upper limit values.

²⁾: In practice, the mineral contents can vary strongly. For a good view of your own situation mineral and trace minerals analyses are recommended.

³⁾: For average values of P, K and Ca in maize silage, reference is made to Table 4.4. This table shows the average contents per DM-category.

4.5b Average and limit values of trace elements in meadow grass, grass silage and maize silage, corn cob with bracts, (ensiled), whole crop silage (cereals) and green cereal plant silage, destined for animal nutrition for ruminants. ^{1) 2)}

		Trace minerals							
		mg/kg DM						µg/kg DM	
		Fe	Mn	Zn	Cu	Mo	I	Co	Se
Meadow grass	Average	186	82	43	8.7	2.4	0.3	77	88
	<i>lower value</i>	70	34	25	5.2	0.8	0.1	31	23
	<i>upper value</i>	357	>180	64	11.3	4.5	0.7	145	183
Grass silage	Average	365	91	42	7.7	1.9	0.4	135	99
	<i>lower value</i>	125	46	30	6.0	0.9	0.1	51	28
	<i>upper value</i>	727	140	57	9.7	3.1	0.8	260	240
Grass clover silage	Average	474	85.8	41	8.7	2.9	0.5	177	111
	<i>lower value</i>	126	30	24	5.8	1.2	0.2	57	36
	<i>upper value</i>	1000	154	59	12.0	5.0	1.0	362	239
Grass hay	Average	397	148	38	6.1	1.6	0.5	156	71
	<i>lower value</i>	94	34	21	3.5	9.4	0.2	38	23
	<i>upper value</i>	936	300	53	8.6	3.1	1.0	392	137
Maize silage	Average ³⁾	109	26	35	3.6	0.5	0.3	42	23
	<i>lower value</i>	71	13	23	2.6	0.3	0.1	40	12
	<i>upper value</i>	157	44	51	5.0	0.9	0.6	49	>36
Corn cob with bracts, ensiled	Average	67	10	32	2.6	0.4	0.1	46	13
	<i>lower value</i>	<40	<10	20	-	-	-	-	-
	<i>upper value</i>	128	19	45	-	-	-	-	-
Whole crop silage (cereals)	average	196	47	47	4.8	1.6	0.3	65	44
Green cereal plant silage	average	282	48	37	4.8	1.1	0.3	86	81
Lucerne silage	average	885	53	38	8.9	3.2	0.9	411	159

4.6 Minerals

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

From:	To	Multiplied 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

5. Relevant CVB publications

Many data in the Table booklet Feeding of Ruminants concerning the feeding standards and feeding advices are derived from CVB reports. The mineral and trace element recommendations for ruminants are derived from the CVB publication 'Handleiding mineralenvoorziening rundvee, schapen, geiten' (2005).

Below you find an overview of the relevant CVB reports. The reports are written in Dutch:

Ruminants (in general)

- Nr. 4: Eiwitbehoefte van schapen en geiten (1992).
- Nr. 11: Herziening van de energie- en eiwitnormen voor vleesstieren (1997)
- Nr. 19: Energie en eiwitnormen voor de voederbehoefte van vrouwelijk jongvee bestemd voor de melkveehouderij (1997)
- Nr. 22: Berekening van het gehalte aan darmverteerbaar methionine en lysine in voedermiddelen voor herkauwers (1998)
- Nr. 23: Structuurwaardesysteem herkauwers (1998)
- Nr. 27: Voeding van drachtige koeien in de droogstand (2001)
- Nr. 28: De fysiologische basis voor de minimale onbestendig eiwit balans in melkveeantsoenen (2001)
- nr. 51: Voeropnamemodel Melkvee . versie 2007 (2007)
- nr. 52: Eiwitwaardering voor herkauwers: het DVE/OEB 2007 systeem (2007)

For extensive information of the mineral and trace elements requirements for cattle, sheep and goats see the "Handleiding Mineralenvoorziening Rundvee, Schapen. Geiten" (CVB. 2005).

For more detailed information about the CVB feeding value systems and detailed information about the composition and nutrient values of feedstuffs you are referred to:

- CVB Veevoedertabel 2016
- Online Voederwaardecalculator

For more information of the CVB products you are referred to the website:

www.cvbdiervoeding.nl

6. List with abbreviations

Abbreviation	Unit	Description
ASH	g	Crude ash
BW	kg	Body weight
BW ^{0.75}	kg	Metabolic Body weight
°C	-	Degree Celsius
Ca	g	Calcium
Cal	-	Calorie (1 cal = 4.184 Joules)
CFAT	g	Crude fat. In most products analyzed without prior acid hydrolysis. In moisture-rich feed ingredients and dried products as maize gluten feed after acid hydrolysis.
CFIBER	g	Crude fiber
Cl	g	Chlorine
CM	kg/day	Corrected milk
Co	mg	Cobalt
CP	g	Crude protein (in ensiled products inclusive NH ₃)
Cu	mg	Copper
DM	g	Dry matter (content)
DVE	g	Darmverteerbaar eiwit = Intestinal digestible protein
%F	%	Fat content in milk
FCM	kg/day	Fat corrected milk
Fe	mg	Iron
FIC		Feed Intake Capacity
FOMp	g	Fermentable organic matter in the rumen
FOSp2	g	Organic matter fermented in the rumen during the first two hours after intake of feed. The ratio FOMp2/FOMp represents how fast a feedstuff will be fermented when incorporated in a balanced ration (the closer the proportional number approaches the value of 1.0, the faster the feedstuff is fermented)
FPCM	kg/day	Fat and protein corrected milk
g	-	Gram
GDM	kg/animal/day	Gross dry matter intake
J	-	Joule (1J = 0.239 calorie)
J	mg	Iodine
K	g	Potassium
kg	-	Kilogram
M	kg	Milk yield per day
mg	-	Milligram
Mg	g/kg	Magnesium
MJ	-	Mega joule (1 MJ = 1000 kJ = 1.000.000 J)
Mn	mg	Manganese

Abbreviation	Unit	Description
N	g	Nitrogen (= CP / 6.25)
Na	g	Sodium
NH ₃	%	Ammonia (fraction) as % of crude protein
OEB	g	Onbestendig Eiwit Balans; rumen degraded protein balance
OEB2	g	OEB two hours after feed intake
P	g	Phosphorus
%P	%	Protein content in milk
Pr	g/day	Milk protein production
S	g	Sulphur
Se	mg	Selenium
STA	g	Starch
SUG	g	Sugar
SW	-	Structuurwaarde; Structure unit
TDMI	kg DM/day	Total Dry Matter Intake
VEM	-	Voedereenheid melkproductie; Feed unit milk production
VEVI	-	Voedereenheid vleesproductie; Feed unit meat production
VW	-	Verzadigingswaarde; Fill unit
Zn	mg	Zinc