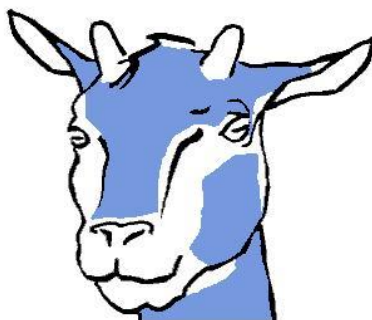
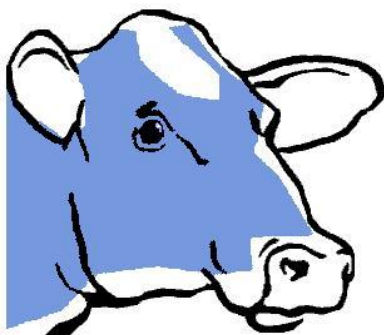


CVB Table Booklet Feeding of Ruminants 2022

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



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Preface

This booklet is an update of the 2016 version. The most relevant adjustments are briefly summarized below:

- Updated energy requirements for dairy cattle.
- Updated body weights of Holstein Friesian dairy cattle.
- Updated VEM contents of feedstuffs (VEM2022).
- Updated feed evaluation of maize silage.
- Introduction of sorghum silage as a new feedstuff.

November 2022.

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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 (VEM2022)

(1 VEM = 7.82 kJ Net Energy for lactation):

VEM (per day) for maintenance and milk production:

Lactating cows

- $\text{VEM2022}_{\text{maintenance}} = 53.0 \times \text{BW}^{0.75} \times \{1 + (\text{VEM2022} - 970) \times 0.000327\}$
- $\text{VEM2022}_{\text{milk production}} = 390 \times \text{FPCM}$

Dry cows

- $\text{VEM2022}_{\text{maintenance}} = 52.7 \times \text{BW}^{0.75} \times \{1 + (\text{VEM2022} - 970) \times 0.000327\}$

BW = body weight in kg;

FPCM = fat and protein corrected milk in kg

VEM2022 = VEM2022 content of the diet (/kg DM)

1.1.1.2 Calculation of FCM and FPCM

FPCM 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). 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 $\times$ 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 for growth.

	BW mean ¹⁾	Additional allowance (per day)	
		VEM2022	g DVE
1 st parity cow	615 kg	625	64
2 nd parity cow	675 kg	325	37
3 rd parity cow	705 kg	125	22
4 th parity cow	720 kg	125	22

Table 1.2 Requirements for the energy and protein requirements of dairy cattle when indoor-fed¹⁾. Body weight: 675 kg. The units are VEM2022/day, g DVE/day and kg milk/day.

% fat	3.50		3.75		4.00		4.25	
% protein	3.03		3.18		3.32		3.45	
kg milk	VEM 2022	DVE	VEM 2022	DVE	VEM 2022	DVE	VEM 2022	DVE
1	7704	201	7719	203	7734	205	7748	207
2	8065	244	8095	248	8124	252	8153	256
3	8426	287	8470	293	8514	299	8557	305
4	8786	331	8846	339	8904	347	8961	355
5	9147	374	9221	385	9294	396	9366	405
6	9508	419	9597	432	9684	444	9770	456
7	9868	463	9972	479	10074	493	10175	507
8	10229	508	10348	526	10464	543	10579	559
9	10590	554	10723	574	10854	593	10984	611
10	10950	599	11099	622	11244	643	11388	663
12	11672	692	11850	720	12025	746	12197	770
14	12393	786	12601	819	12805	850	13006	878
16	13114	881	13352	919	13585	955	13815	989
18	13836	978	14103	1021	14365	1062	14623	1101
20	14557	1076	14853	1125	15145	1171	15432	1215
22	15278	1176	15604	1231	15925	1282	16241	1330
24	16000	1277	16355	1338	16706	1395	17050	1448
26	16721	1379	17106	1446	17486	1509	17859	1568
28	17442	1483	17857	1556	18266	1625	18668	1689
30	18164	1589	18608	1668	19046	1742	19477	1812
32	18885	1695	19359	1781	19826	1862	20285	1937
34	19606	1804	20110	1896	20606	1983	21094	2064
36	20328	1913	20861	2012	21386	2106	21903	2193
38	21049	2024	21612	2130	22167	2230	22712	2324
40	21771	2137	22363	2250	22947	2356	23521	2456
42	22492	2251	23114	2371	23727	2484	24330	2591
44	23213	2366	23865	2494	24507	2614	25139	2727
46	23935	2483	24616	2618	25287	2745	25947	2865
48	24656	2601	25367	2744	26067	2878	-	-
50	25377	2721	26118	2871	26848	3013	-	-

¹ The maintenance requirement is included in the requirements including a VEM2022 and DVE requirement for growth of 325 VEM2022 and 37 g DVE. In case of day and night grazing it is advised to increase the energy requirement for maintenance of 53 with 30% to 68.9 VEM2022 per kg of BW^{0.75}.

Table 1.2 Requirements for the energy and protein requirements of dairy cattle when indoor-fed¹⁾. Body weight: 675 kg. The units are VEM2022/day, g DVE/day and kg milk/day.

% fat % protein kg milk	4.50 3.60		4.75 3.75		5.00 3.88	
	VEM 2022	DVE	VEM 2022	DVE	VEM 2022	DVE
1	7763	209	7778	211	7792	213
2	8182	260	8212	264	8240	268
3	8601	312	8646	318	8689	324
4	9021	364	9080	372	9137	380
5	9440	416	9514	427	9586	437
6	9859	469	9948	482	10034	494
7	10278	523	10382	538	10483	552
8	10698	577	10816	595	10931	611
9	11117	631	11250	652	11379	670
10	11536	686	11684	709	11828	730
12	12375	798	12552	826	12725	851
14	13213	912	13421	945	13622	974
16	14052	1027	14289	1066	14518	1100
18	14890	1145	15157	1190	15415	1229
20	15729	1265	16025	1315	16312	1359
22	16567	1386	16893	1443	17209	1492
24	17406	1510	17761	1573	18106	1628
26	18244	1636	18629	1705	19003	1765
28	19083	1764	19498	1839	19899	1905
30	19921	1894	20366	1976	20796	2048
32	20760	2025	21234	2115	21693	2192
34	21598	2159	22102	2255	22590	2339
36	22437	2295	22970	2399	-	-
38	23275	2433	23838	2544	-	-
40	24114	2573	-	-	-	-
42	24952	2715	-	-	-	-
44	-	-	-	-	-	-
46	-	-	-	-	-	-
48	-	-	-	-	-	-
50	-	-	-	-	-	-

¹ The maintenance requirement is included in the requirements including a VEM2022 and DVE requirement for growth of 325 VEM2022 and 37 g DVE. In case of day and night grazing it is advised to increase the energy requirement for maintenance of 53 with 30% to 68.9 VEM2022 per kg of BW^{0.75}.

1.1.3 Additional allowance for pregnant cows

The energy and protein requirements for gestation are very low during the first 4 months. For gestating cows, additional energy and protein should be given from the 5th month of gestation for the growth of the calf, uterus, amnion and chorion, et cetera. Table 1.3 represents the **additional allowances** for VEM2022 and DVE from the 4th month of gestation for a cow with a body weight of 675 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 4th month of gestation.¹⁾

Month in gestation	Additional allowance (per day)	
	VEM2022	g DVE
4 th month	250	15
5 th month	400	30
6 th month	650	55
7 th month	1100	100
8 th month (dry)	1700	160
9 th month (dry)	2750	255

¹⁾ 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 (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 Requirements¹⁾ for the nutrient requirements with indoor-feeding of young stock destined for dairy cattle ^{2) 3)}

		Daily gain g per day ⁵⁾						additional VEM2022 when grazing
Age (months)	BW (kg)	850		700		625		
		VEM 2022	DVE	VEM 2022	DVE	VEM 2022	DVE	
2	75	2600	225	2350	195	-	-	350
4	130	3200	255	2925	225	-	-	500
6	185	3800	285	3450	250	-	-	650
8	235	4525	305	4100	270	-	-	800
10	280	5225	325	4725	290	-	-	900
12	320	-	-	5225	310	4950	290	900
14	360	-	-	5725	330	5450	310	1050
16	400	-	-	6250	350	5925	335	1150
18	440	-	-	6825	375	6500	355	1250
20	480	-	-	7575	435	7225	415	1350
22	BW 510 kg (ca. 400 g growth/d ⁴⁾)				7375 VEM2022; 400 g DVE			1400
23	highly pregnant (ca. 200 g growth/d ⁴⁾)				7625 VEM2022; 450 g DVE			1400
24	highly pregnant (ca. 150 g growth/d ⁴⁾)				8550 VEM2022; 525 g DVE			1450

¹⁾ The requirements for VEM2022 and DVE (in g) are on a daily basis. The requirements for female young stock have been described in CVB Documentation report nr. 19: "Energie en eiwitnormen voor de voederbehoefte van vrouwelijk jongvee bestemd voor de melkveehouderij (1997).

²⁾ When grazing, the VEM2022 requirements for maintenance are app. 30% 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⁾ 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 or 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)	+ (resp. -) 0.008
Fat contents higher (resp. lower) than 4.4 % (correction per % fat)	- (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:

$$\begin{aligned} \text{SW}_{\text{requirement}} &= 1.0 + (\text{milk production} - 25) * 0.008 - (\% \text{fat} - 4.4\%) * 0.050 \\ &= 1.0 + (32 - 25) * 0.008 - (4.2\% - 4.4\%) * 0.050 \\ &= 1.0 + 0.056 + 0.010 = 1.066 \end{aligned}$$

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 ($\text{VW}_{\text{ration}}$ 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:

$$\begin{aligned} \text{VW}_{\text{ration}} &= (\text{proportion roughage}_1 \text{ in ration} * \text{VW roughage}_1) + \\ &\quad (\text{proportion roughage}_2 \text{ in ration} * \text{VW roughage}_2) + \\ &\quad (\text{proportion concentrate}_1 \text{ in ration} * \text{VW concentrate}_1) + \\ &\quad (\text{proportion concentrate}_2 \text{ in ration} * \text{VW concentrate}_2) + \\ &\quad \text{etc.} \end{aligned}$$

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:

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

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: $TDMI = FIC/VW_{\text{diet}} = 15.8/0.78 = 20.3 \text{ kg DM/day}$.

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, than 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.

		VEM2022/kg DM roughage					
		430 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

		VEM2022/kg DM roughage					
		850			960		
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	4.3	0.0
300	700	6.1	5.9	0.0	6.6	5.3	0.0
400	625	7.3	7.2	0.0	7.9	6.4	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 960 VEM2022/kg DM, the gross DM intake is 10% higher than the indoor forage intake.

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 IJsselvee (MRIJ))¹⁾.

BW ²⁾ (kg)	DM-intake ³⁾ (kg/day)	Gain (g/day)					
		1000		1100		1200	
		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⁾ (kg)	DM-intake ³⁾ (kg/day)	Gain (g/day)							
		1300		1400		1500		1600	
		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⁾ (kg)	DM-intake ³⁾ (kg/day)	Gain (g/day)					
		1000		1100		1200	
		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⁾ (kg)	DM-intake ³⁾ (kg/day)	Gain (g/day)							
		1300		1400		1500		1600	
		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 VEVl 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) = $30 \times BW^{0.75}$**
- **DVE_(maintenance, including wool growth) (g/day) = $1.5 \times BW^{0.75}$**

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 ($30 \times BW^{0.75}$) 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 ($= 30 \times BW^{0.75}$) 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:

- $$\text{VEM} = (36.4 \times \text{BW}^{0.75} + 442 \times \text{FCM}) \times \{1 + (\text{FCM} - 2.75) \times 0.0009\}$$

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:

- $$\text{VEM}_{\text{maintenance + production}} = 879 + 443 \times \text{FCM (VEM per day)}$$

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 2022-edition of the CVB Feed 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, VEM2022, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Barley	873	21	102	18	47	502	22	3.2	0.5	4.9	980	980	1070	611	79	-24	-0.05	0.25
Barley feed, high grade	884	55	133	45	108	234	50	6.3	1.7	8.0	835	853	891	497	63	15	0.16	0.27
Barley, mill by-product	886	64	118	38	138	202	23	4.1	2.6	7.7	728	754	765	460	52	11	0.24	0.29
Bread (remains)	897	27	124	44	11	499	68	1.9	0.7	2.7	1153	1141	1271	662	85	-13	-0.22	0.26
Brewer's grains, dried	915	46	248	67	132	40	9	4.6	3.5	0.5	789	821	823	382	137	57	0.37	0.29
Brewer's yeast, dried	924	65	459	8	18	68	27	10.6	2.0	18.1	884	909	936	389	233	118	0.23	0.27
Carob pods	897	30	42	8	67	0	421	0.5	4.0	8.3	768	785	819	614	53	-66	-0.12	0.26
Casein	916	32	872	11	0	0	0	5.3	1.8	1.2	1158	1176	1245	700	191	624	0.29	0.26
Chicory pulp, dried	897	74	83	17	192	6	85	1.2	10.9	5.3	900	908	975	634	88	-61	0.37	0.31
Citrus pulp	912	66	64	21	127	10	178	1.0	14.9	9.5	968	969	1056	684	77	-64	0.21	0.29
Copra cake CFAT < 100 g/kg	907	61	204	85	113	11	100	5.5	0.8	21.2	1060	1066	1152	483	158	-5	0.28	0.28
Copra cake CFAT > 100 g/kg	941	63	210	122	127	11	75	5.4	1.0	21.1	1189	1191	1297	471	160	-1	0.33	0.30
Copra meal	910	69	227	23	129	9	77	5.7	1.5	21.0	888	904	952	515	174	-1	0.32	0.29
Cotton seed exp. dehulled, CF < 140 g/kg	932	63	416	105	129	11	39	11.2	2.4	14.7	1011	1036	1077	354	190	161	0.37	0.29
Cotton seed exp. non-deh., CF > 210 g/kg	921	51	307	61	230	11	39	10.3	2.3	14.5	792	827	821	377	141	101	0.47	0.34
Cotton seed exp. partly deh., CF 140 - 210 g/kg	933	60	363	74	170	11	38	10.2	2.2	14.4	889	919	934	378	168	130	0.41	0.31
Cotton seeds delinted, CF < 100 g/kg	935	44	403	308	28	0	41	7.5	1.2	9.4	1705	1682	1883	330	127	228	0.28	0.27
Cotton seeds whole, CF > 100 g/kg	911	40	207	192	236	0	29	6.8	1.4	11.1	1119	1138	1202	340	65	91	0.49	0.34
Cottonseed meal, solvent extracted dehulled, CF < 140 g/kg	898	65	437	31	120	20	28	10.7	2.2	15.7	795	826	829	443	148	227	0.36	0.28
Cottonseed meal, solvent extracted non-dehulled, CF > 200 g/kg	945	50	296	38	217	21	37	10.8	2.1	16.0	764	800	789	465	104	129	0.45	0.34
Cottonseed meal, solvent extracted partly dehulled, CF 140 - 200 g/kg	896	63	364	25	166	20	45	10.2	2.0	15.2	730	763	754	439	125	179	0.38	0.30
DDGS, Maize	903	44	268	125	67	29	17	8.2	0.2	11.4	1179	1182	1285	395	166	57	0.31	0.26
DDGS, Wheat	916	46	324	68	71	11	49	8.4	0.0	0.0	1059	1071	1146	486	172	99	0.30	0.27

4.2 Ingredients for concentrate of ruminants (VEM, VEM2022, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Fat/oil, Animal fat 6% linolzuur	994	1	0	993	0	0	0	0.0	0.0	0.2	3413	3264	3843	-99	0	15	0.32	0.29
Fat/oil, Vegetable	995	0	0	995	0	0	0	0.0	0.0	0.0	3708	3514	4191	-49	0	7	0.32	0.29
Feed beans, heat treated	862	52	229	16	45	326	40	4.6	1.6	15.2	975	977	1064	561	123	58	0.10	0.25
Grass meal CP < 140 g/kg	929	108	122	25	235	13	122	3.2	5.3	24.1	710	737	742	501	69	-21	0.38	0.34
Grass meal CP > 200 g/kg	917	126	208	40	201	13	88	3.9	5.3	31.5	771	795	814	479	99	45	0.38	0.32
Grass meal CP 140 - 160 g/kg	928	123	151	32	212	13	106	3.6	5.3	27.3	746	770	786	493	77	-1	0.37	0.33
Grass meal CP 160 - 200 g/kg	929	121	177	38	211	13	90	3.8	5.3	29.1	765	789	806	488	90	18	0.39	0.33
grass seed	863	47	107	11	104	427	13	0.0	0.0	0.0	586	617	600	387	47	2	0.07	0.27
Groundnut exp. dehulled, CF < 75 g/kg	932	64	476	81	61	62	93	4.8	2.3	9.9	1168	1176	1267	539	178	253	0.21	0.27
Groundnut expeller non-dehulled, CF > 145 g/kg	933	41	346	97	157	62	93	4.8	2.3	9.9	1078	1096	1159	497	131	168	0.30	0.31
Groundnut expeller partly dehulled, CF 75 - 145 g/kg	920	51	423	87	95	61	92	4.7	2.2	9.8	1128	1139	1220	519	159	219	0.24	0.28
Groundnut meal dehulled, CF < 75 g/kg	913	60	456	12	64	60	75	6.4	1.8	12.5	964	981	1034	588	176	232	0.23	0.26
Groundnut meal partly dehulled, CF 75 - 145 g/kg	926	56	529	9	116	61	76	6.5	1.8	12.7	925	950	980	557	192	287	0.28	0.29
Groundnuts dehulled, CF < 85 g/kg	932	22	287	490	23	62	30	4.4	1.0	5.4	2363	2279	2649	272	89	160	0.24	0.27
Groundnuts non-dehulled., CF > 85 g/kg	942	28	245	353	174	62	30	4.2	1.5	13.0	1739	1718	1920	301	72	127	0.39	0.32
Hemp seed	913	48	195	316	169	0	0	8.1	1.5	0.0	1266	1283	1365	157	49	97	0.46	0.31
Horse beans, coloured flowering	869	33	254	12	77	328	29	5.1	1.1	12.1	1017	1019	1109	623	108	100	0.16	0.26
Horsebeans, white flowering	867	33	264	10	82	336	39	5.1	1.5	13.2	1009	1012	1100	619	109	108	0.15	0.26
Lentils	873	30	230	13	45	413	48	3.8	0.8	9.4	1007	1009	1098	600	96	85	0.07	0.25
Linseed	922	39	212	401	95	14	22	5.3	2.4	7.4	1810	1779	2005	253	67	107	0.35	0.28
Linseed expeller	922	58	340	80	90	23	38	8.2	3.5	12.1	1019	1036	1095	454	167	113	0.32	0.28
Linseed meal	872	55	320	30	96	35	43	8.4	3.1	10.9	843	864	895	463	160	101	0.29	0.27
Lucerne (alfalfa) meal CP < 140 g/kg	918	90	100	18	301	11	28	2.4	9.1	18.0	583	617	588	443	49	-30	0.55	0.36
Lucerne (alfalfa) meal CP > 180 g/kg	906	115	191	29	233	11	26	2.8	15.5	29.4	667	697	689	436	90	32	0.48	0.34

4.2 Ingredients for concentrate of ruminants (VEM, VEM2022, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Lucerne (alfalfa) meal CP 140 - 160 g/kg	913	103	152	22	286	11	38	2.5	15.8	26.0	587	622	592	416	70	6	0.52	0.36
Lucerne (alfalfa) meal CP 160 - 180 g/kg	914	110	168	25	276	11	40	2.7	16.1	27.3	599	633	607	414	76	17	0.51	0.36
Lupins CP < 335 g/kg	895	28	303	52	153	12	50	3.4	2.3	8.0	1132	1135	1235	666	127	129	0.37	0.30
Lupins CP > 335 g/kg	878	38	360	46	137	21	48	3.5	2.3	8.1	1096	1101	1192	637	137	177	0.34	0.28
Maize	863	12	75	37	24	596	13	2.5	0.0	3.3	1097	1085	1211	459	83	-43	0.15	0.25
Maize bran	894	23	93	41	91	302	18	4.7	0.3	0.0	956	964	1035	542	75	-31	0.21	0.27
Maize feed flour	875	6	76	12	8	685	10	0.7	0.2	1.2	1107	1092	1224	603	83	-50	-0.05	0.25
Maize feed meal	879	22	89	63	41	463	23	4.0	0.6	5.2	1117	1108	1229	538	78	-33	0.08	0.25
Maize feed meal, solvent extracted	867	13	86	33	26	489	26	3.9	0.5	6.2	1087	1076	1198	582	83	-41	0.04	0.25
Maize germ meal, solvent extracted	876	25	226	26	89	213	3	5.2	0.5	4.5	918	932	987	522	129	44	0.27	0.26
Maize gluten feed CP < 200 g/kg	882	54	185	20	72	161	16	9.5	0.7	12.0	948	956	1025	534	93	43	0.25	0.26
Maize gluten feed CP > 230 g/kg	889	62	240	30	74	97	26	9.5	1.9	11.2	950	961	1027	540	87	103	0.28	0.26
Maize gluten feed CP 200 - 230 g/kg	893	56	205	30	76	121	17	9.6	2.1	12.6	959	968	1041	543	91	65	0.28	0.26
Maize gluten meal	899	17	604	60	10	176	2	4.6	0.3	1.4	1205	1213	1309	310	475	73	0.17	0.26
Maize starch	892	1	6	5	2	851	0	0.4	0.0	0.0	1192	1164	1327	658	0	-95	-0.11	0.26
Maize, chemical/heat treated	876	13	78	33	18	610	15	2.9	0.3	3.5	1135	1120	1254	661	105	-73	-0.25	0.25
Maize, distillers solubles, dried	894	50	260	98	71	54	18	8.0	1.1	11.0	1078	1085	1170	479	138	68	0.30	0.26
Malt culms CP < 200 g/kg	918	46	186	18	128	121	106	5.0	1.8	12.6	688	720	710	500	60	66	0.32	0.29
Malt culms CP > 200 g/kg	914	54	218	18	123	101	98	5.6	1.8	12.5	837	858	890	585	82	77	0.33	0.29
Milk powder, whole	949	59	267	243	0	0	367	7.6	9.4	12.4	1738	1690	1940	549	104	123	-0.11	0.27
Milkpowder, skimmed	951	79	356	8	0	0	489	10.2	12.6	16.5	1117	1113	1224	741	140	162	-0.24	0.27
Millet	881	32	111	40	99	497	8	2.8	0.1	3.0	891	904	958	425	80	-22	0.16	0.27
Millet, (pearl millet)	912	25	122	45	20	606	14	3.3	0.2	3.5	1066	1065	1165	480	95	-26	0.04	0.26
Molasses, sugarbeet	787	90	98	2	0	0	512	0.5	0.7	41.0	810	805	890	619	51	0	-0.32	0.23
Molasses, sugarcane SUG < 475 g/kg	724	112	51	1	6	0	454	0.7	7.9	41.0	594	601	643	484	34	-24	-0.27	0.21

4.2 Ingredients for concentrate of ruminants (VEM, VEM2022, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Molasses, sugarcane SUG > 475 g/kg	721	91	41	1	6	0	488	0.6	6.8	28.8	618	623	669	502	36	-37	-0.31	0.21
Niger seed	916	47	203	409	145	8	35	6.9	4.0	8.2	1716	1697	1893	177	66	94	0.39	0.30
Oats	879	24	100	43	106	374	9	3.0	0.7	3.9	903	916	972	550	58	-7	0.09	0.27
Oats husk meal	910	42	48	18	268	182	11	1.4	2.3	4.5	518	555	509	407	18	-28	0.40	0.35
Oats mill feed, high grade	886	24	91	44	118	269	10	3.6	0.7	0.0	888	903	954	553	56	-14	0.18	0.28
Oats, peeled	888	20	129	63	13	545	14	4.3	0.6	4.0	1203	1187	1330	637	82	2	-0.14	0.25
Palm kernel expeller CF < 180 g/kg	919	42	159	85	167	3	15	5.9	2.9	6.6	1032	1044	1116	492	123	-27	0.44	0.31
Palm kernel expeller CF > 180 g/kg	927	43	152	85	198	2	15	5.7	2.9	6.7	979	996	1049	470	115	-26	0.47	0.32
Palm kernel, solvent extr. CF < 190 g/kg	893	39	158	24	173	2	12	6.0	2.8	7.1	852	871	909	527	127	-33	0.44	0.30
Palm kernel, solvent extr. CF > 190 g/kg	876	40	150	16	204	2	12	5.9	2.7	6.9	735	761	771	480	114	-28	0.47	0.31
Palm kernels	938	20	92	480	97	2	15	3.1	1.2	0.0	2214	2141	2479	260	58	0	0.38	0.28
Peas	866	29	201	10	53	416	43	3.8	0.9	10.0	1025	1023	1123	617	98	61	0.09	0.25
Potato crisps	962	35	59	300	11	444	28	1.4	0.3	11.2	1638	1608	1817	426	54	-32	0.29	0.53
Potato protein ASH < 10 g/kg	908	5	797	10	6	1	9	1.6	0.4	0.2	1090	1115	1164	288	511	208	0.29	0.26
Potato protein ASH > 10 g/kg	904	20	773	10	9	1	5	2.0	0.5	6.9	1062	1086	1134	283	495	202	0.29	0.26
Potato pulp, dried CP < 90 g/kg	876	47	61	2	164	251	12	1.0	2.7	12.7	853	863	922	602	67	-59	0.29	0.30
Potato pulp, dried CP 90 - 130 g/kg	880	69	96	4	151	244	12	1.3	2.6	25.1	837	848	903	572	77	-36	0.29	0.29
Potato starch, dried	863	5	6	1	4	703	0	0.7	0.3	0.9	1116	1092	1241	628	56	-89	-0.01	0.25
Potatoes, dried	897	42	93	4	25	599	31	2.4	0.5	12.1	953	953	1040	510	69	-20	0.08	0.26
Rape seed	925	38	192	422	114	15	29	6.3	4.3	7.4	1917	1876	2131	268	38	102	0.36	0.29
Rape seed expeller	902	62	315	101	122	7	77	10.2	6.9	11.3	1041	1055	1122	450	124	126	0.31	0.28
Rape seed meal, rumen bypass, Mervobest	877	67	333	30	132	10	93	10.9	7.2	13.0	803	828	847	309	275	-12	0.30	0.28
Rape seed meal, solv. extr. CP < 370 g/kg	882	69	339	28	125	8	85	10.5	7.5	12.2	835	857	885	483	134	136	0.30	0.28

4.2 Ingredients for concentrate of ruminants (VEM, VEM2022, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Rape seed meal, solv. extr. CP>370 g/kg	897	80	383	18	115	11	88	10.6	7.1	12.5	828	852	877	489	148	162	0.29	0.28
Rice bran meal, solvent extracted	901	108	143	15	113	270	26	16.5	1.1	12.3	693	717	729	472	57	25	0.16	0.28
Rice dehulled	885	7	78	8	7	715	9	0.9	0.1	0.9	1091	1078	1204	692	81	-51	-0.27	0.25
Rice feed meal ASH < 90 g/kg	901	75	139	160	56	264	48	15.1	4.7	9.9	1109	1114	1208	420	61	31	0.09	0.26
Rice feed meal ASH > 90 g/kg	912	121	137	176	60	215	31	17.0	24.9	10.0	1078	1084	1173	368	53	37	0.15	0.26
Rice husk	912	152	68	52	265	127	9	11.0	3.6	9.4	397	434	372	232	-1	11	0.45	0.35
Rice with hulls	886	44	73	19	102	463	13	2.6	0.4	3.4	809	825	865	542	53	-32	0.01	0.27
Rye	870	16	93	13	21	514	55	3.1	0.4	4.6	1012	1007	1110	658	73	-28	-0.16	0.25
Rye feed	872	50	141	32	60	129	10	4.4	0.8	6.3	873	885	941	568	67	22	0.23	0.25
Safflower seed	907	28	122	273	340	0	17	0.0	0.0	0.0	957	997	996	99	-7	82	0.61	0.36
Sesame seed	942	75	220	429	43	0	14	5.6	11.0	5.2	1954	1906	2177	254	57	125	0.33	0.27
Sesame seed expeller	943	132	451	115	62	0	25	9.8	19.1	9.4	1140	1148	1237	418	179	217	0.34	0.27
Sesame seed meal, solvent extracted	893	60	430	16	117	0	63	12.9	23.0	10.4	887	910	943	516	182	189	0.33	0.28
Sorghum	872	15	87	28	23	606	8	2.7	0.3	3.5	1011	1008	1107	407	73	-30	0.17	0.25
Sorghum gluten meal	900	32	430	54	36	246	0	3.0	0.0	0.0	1132	1138	1231	444	247	98	0.17	0.26
Soya bean expeller	916	64	439	81	63	8	84	6.3	2.7	21.6	1208	1208	1319	519	239	163	0.18	0.26
Soya bean hulls CF < 320 g/kg	883	48	129	28	306	9	17	1.7	5.8	12.4	921	935	992	616	97	-30	0.55	0.35
Soya bean hulls CF > 360 g/kg	887	45	101	16	360	6	12	1.1	5.2	12.2	873	890	934	632	90	-50	0.61	0.35
Soya bean hulls CF 320 - 360 g/kg	886	46	105	21	344	7	16	1.2	5.3	12.9	889	905	953	627	91	-46	0.59	0.35
Soya bean meal, rumen bypass, CovaSoy	872	63	462	16	43	6	100	6.4	2.6	21.7	980	991	1058	358	397	15	0.14	0.25
Soya bean meal, rumen bypass, Mervobest	873	60	454	17	59	10	96	5.7	2.8	21.2	983	995	1062	368	387	16	0.14	0.25
Soya bean meal, solv. extr. CF > 70 g/kg	878	65	421	15	75	13	80	5.8	2.9	22.0	989	999	1071	550	232	148	0.19	0.26
SBM, solvent. extracted CF 45 - 70 g/kg	880	63	436	15	63	9	86	5.9	2.9	22.1	999	1008	1081	549	238	156	0.17	0.25
SBM, solvent extracted CF 45 - 70 g/kg	877	64	467	15	48	5	84	6.4	2.9	22.0	1002	1012	1085	536	251	176	0.15	0.25
Soya beans, heat treated	882	65	469	13	37	11	92	6.7	2.9	22.1	1006	1016	1089	541	253	176	0.12	0.25

4.2 Ingredients for concentrate of ruminants (VEM, VEM2022, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Soya beans, raw	899	50	362	198	49	7	67	5.1	2.2	17.0	1439	1425	1585	475	113	205	0.17	0.26
Sugar	1000	0	0	0	0	0	1053	0.0	0.0	0.0	1363	1080	1250	1000	0	-150	-0.86	0.29
Sugarbeet pulp, dried SUG < 100 g/kg	893	61	75	9	175	7	68	0.8	9.9	4.0	928	933	1009	665	91	-71	0.38	0.31
Sugarbeet pulp, dried SUG > 200 g/kg	912	76	102	7	130	7	219	0.7	7.8	6.6	940	942	1021	679	93	-47	0.17	0.29
Sugarbeet pulp, dried SUG 100 - 150 g/kg	901	67	88	8	166	7	123	0.7	9.0	14.4	928	932	1012	667	94	-61	0.31	0.30
Sugarbeet pulp, dried SUG 150 - 200 g/kg	906	77	97	7	137	7	182	0.7	7.9	5.4	930	933	1013	670	93	-52	0.21	0.29
Sunflower seed dehulled, CF < 90 g/kg	915	37	207	515	74	4	23	5.0	2.3	7.1	2132	2077	2377	179	46	130	0.34	0.27
Sunflower seed expeller dehulled, CF < 200 g/kg	926	63	335	88	180	5	56	11.3	2.9	14.3	942	968	998	430	126	152	0.41	0.32
Sunflower seed exp. non-deh., CF > 315	913	56	183	103	372	2	26	5.5	2.9	12.9	579	624	563	217	40	85	0.63	0.36
Sunflower seed exp. partly dehulled, CF 200 - 315	923	58	298	96	227	4	47	10.0	2.9	13.0	861	893	900	377	105	136	0.46	0.34
Sunflower seed meal, solvent extracted non-dehulled, CF > 245 g/kg	885	62	272	16	268	8	36	9.7	3.5	13.5	571	610	568	380	94	119	0.50	0.35
Sunflower seed meal, solvent extracted partly dehulled, CF 150 - 195 g/kg	901	66	368	9	176	8	63	11.6	3.6	15.6	755	786	787	482	142	165	0.38	0.31
Sunflower seed meal, solvent extracted partly dehulled, CF 195 - 245 g/kg	891	66	308	16	224	3	50	10.6	3.5	15.2	659	694	672	423	113	135	0.45	0.33
Sunflower seed non-deh., CF > 200 g/kg	940	29	141	372	277	4	19	4.4	2.4	8.0	1368	1386	1474	126	10	88	0.55	0.37
Sunflower seed partly dehulled, CF 90 - 200 g/kg	938	32	169	441	179	4	20	4.8	2.3	8.0	1739	1726	1913	164	28	104	0.45	0.32
Sweet potatoes, dried	878	38	40	6	27	592	68	1.3	1.7	5.8	941	939	1030	631	63	-72	-0.23	0.25
Tapioca starch	880	1	11	2	2	855	0	0.4	0.2	0.0	1154	1129	1283	736	0	-104	-0.43	0.25
Tapioca, dried STAew < 630 g/kg	883	58	23	5	62	593	9	0.7	4.1	6.0	892	894	973	612	53	-79	-0.16	0.26
Tapioca, dried STAew 630 - 680 g/kg	879	58	23	5	53	620	8	0.7	2.5	6.2	908	907	993	617	54	-80	-0.19	0.25
Tapioca, dried STAew 680 - 730 g/kg	873	51	23	4	48	653	7	0.9	2.0	6.6	919	917	1006	620	56	-80	-0.22	0.25
Triticale	867	17	103	13	22	546	29	3.2	0.4	4.8	1040	1032	1144	668	78	-22	-0.15	0.25
Vinasse, beet CP < 240 g/kg	652	176	206	0	1	0	40	1.2	4.1	68.6	569	572	618	417	32	132	0.17	0.19

4.2 Ingredients for concentrate of ruminants (VEM, VEM2022, VEVI, SW en VW per kg product; DM and other nutrients and nutritional values in g/kg product)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Vinasse, beet CP > 240 g/kg	657	98	270	2	0	0	44	1.7	2.3	26.6	671	675	728	488	40	182	0.16	0.19
Wheat	867	15	110	15	23	561	26	3.0	0.3	3.8	1040	1033	1143	660	81	-17	-0.16	0.25
Wheat germ feed	866	40	179	46	52	257	65	9.1	0.9	10.3	950	958	1030	564	75	52	0.06	0.25
Wheat germs	872	41	264	85	35	204	109	7.9	0.5	9.4	1128	1125	1234	558	92	119	0.04	0.25
Wheat gluten feed, dried ASH < 40 g/kg	888	36	144	31	55	294	82	6.3	1.0	11.1	911	922	982	560	84	6	0.01	0.25
Wheat gluten feed, dried ASH > 60 g/kg	911	65	160	41	65	190	120	10.1	1.1	11.4	876	892	939	530	84	20	0.07	0.26
Wheat gluten feed, dried ASH 40 - 50 g/kg	901	48	156	45	81	196	77	8.8	1.1	11.8	841	862	896	505	78	21	0.13	0.27
Wheat gluten feed, dried ASH 50 - 60 g/kg	901	52	167	45	82	184	84	9.6	1.1	12.5	831	853	884	494	80	30	0.13	0.27
Wheat gluten meal	911	9	781	56	5	29	28	1.8	0.7	1.2	1274	1284	1381	544	278	412	0.24	0.26
Wheat milling by-products Wheat bran CF < 125 g/kg	869	53	149	32	109	138	58	10.6	1.0	13.3	718	744	754	478	52	43	0.23	0.27
Wheat milling by-products Wheat bran CF > 125 g/kg	874	61	142	29	126	102	47	12.3	1.0	15.1	654	683	676	450	45	41	0.28	0.28
Wheat milling by-products Wheat feed flour	872	29	153	38	45	334	63	5.5	0.8	9.7	985	989	1073	602	75	27	0.00	0.25
Wheat milling by-products Wheat feed meal	870	43	154	36	72	230	63	8.6	1.0	12.5	864	878	928	545	65	36	0.11	0.26
Wheat milling by-products Wheat flour	871	16	141	24	11	562	47	4.0	0.4	3.9	1103	1092	1216	672	85	8	-0.19	0.25
Wheat milling by-products Wheat middlings	871	47	152	36	88	182	56	9.6	0.9	12.7	804	824	856	516	60	39	0.17	0.26
Whey powder	982	81	130	8	0	0	702	6.1	5.4	23.6	1127	1112	1245	809	98	-22	-0.47	0.28
Whey powder, low lactose ASH < 210 g/kg	956	177	252	53	0	0	467	14.7	17.6	45.3	1071	1061	1179	623	104	100	-0.22	0.27
Whey powder, low lactose ASH > 210 g/kg	962	230	217	41	0	0	444	19.6	33.8	48.7	981	972	1079	596	93	77	-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, VEM2022, VEVI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg DM)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Brewer's grains, Meura filter process	258	42	260	103	182	16	23	5.6	4.9	0.4	912	947	952	366	138	65	1.00	0.55
Brewer's grains, traditional process DM < 250 g/kg	222	43	243	106	176	21	6	6.7	4.6	0.5	910	945	951	368	129	57	1.00	0.55
Brewer's grains, traditional process DM > 250 g/kg	265	43	247	104	179	20	15	6.5	4.1	0.7	906	941	947	368	131	58	1.00	0.55
Carrot peelings, steam peeled	52	138	96	22	124	0	25	5.0	6.1	46.0	1102	1094	1211	518	85	-42	1.10	0.69
Cheese whey, fresh CP < 175 g/kg DM	44	96	153	47	0	0	591	7.5	9.5	26.1	1216	1198	1345	714	61	38	-0.40	0.30
Cheese whey, fresh CP > 275 g/kg DM	31	141	327	80	0	0	182	12.7	16.1	36.1	1247	1236	1373	463	37	239	-0.10	0.30
Cheese whey, fresh CP 175 - 275 g/kg DM	38	106	210	72	0	0	468	9.1	12.1	27.9	1260	1243	1393	649	55	101	-0.20	0.30
Chicory press pulp, fresh and ensiled	232	95	83	12	233	0	49	1.5	8.7	7.8	975	985	1055	675	93	-70	1.05	0.70
Corn cob mix (CCM), silage partly with rachis, CF 40 - 60 g/kg DM	632	18	96	43	45	613	3	3.0	0.1	4.0	1183	1179	1297	550	68	-21	0.50	0.66
Corn cob mix (CCM), silage with rachis, CF > 60 g/kg DM	525	21	99	38	72	588	3	3.0	0.1	4.0	1149	1149	1255	539	67	-19	0.60	0.75
Corn cob mix (CCM), silage without rachis, CF < 40 g/kg DM	662	16	99	48	23	675	7	3.0	0.1	4.0	1219	1212	1339	538	67	-16	0.40	0.65
Maize gluten feed, fresh and ensiled STAew < 200 g/kg DM	414	57	198	38	134	88	17	9.9	0.3	16.3	1052	1064	1137	620	103	37	0.60	0.55
Maize gluten feed, fresh and ensiled STAew > 200 g/kg DM	418	39	166	38	86	308	12	6.8	0.3	10.6	1092	1099	1186	561	105	7	0.60	0.55
Maize solubles	476	177	429	6	5	3	80	31.8	0.6	51.6	1001	1009	1086	627	50	311	0.10	0.30
Potato cuttings/chips, raw	212	31	80	2	26	717	20	1.7	0.7	12.9	1135	1128	1247	487	59	-19	0.60	0.55
Potato fruit-juice concentrated	548	290	327	0	0	0	57	11.1	0.9	138.5	895	896	978	645	66	212	0.10	0.30
Potato peelings, steamed STAam < 350 g/kg DM	119	81	155	13	71	257	35	2.7	2.1	31.3	1083	1082	1184	635	90	12	0.55	0.45
Potato peelings, steamed STAam > 600 g/kg DM	157	53	102	8	34	633	9	2.5	0.9	22.9	1119	1113	1228	702	84	-35	0.40	0.45
Potato peelings, steamed STAam 350 - 475 g/kg DM	138	69	137	11	56	416	19	2.6	1.6	27.3	1099	1097	1204	668	89	-6	0.50	0.45

4.3 Wet by-products (DM in g/kg product; VEM, VEM2022, VEVI, VW and SW per kg dry matter; other nutrients and nutritional values in g/kg DM)

	DM	ASH	CP	CFAT	CFIBER	STA	SUG	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Potato peelings, steamed STAam 475 - 600 g/kg DM	145	57	116	8	40	536	12	2.5	1.2	24.8	1114	1109	1221	696	87	-25	0.45	0.45
Potato pulp, pressed,	150	62	109	2	194	225	11	1.7	1.2	29.0	1011	1019	1095	595	109	-65	0.80	0.55
Potato pulp, pressed, Dutch origin	161	43	81	2	206	191	11	0.9	1.4	18.0	1022	1031	1108	611	94	-74	0.80	0.55
Potato starch, untreated, liquid STAam < 600 g/kg DM	201	66	112	5	43	519	23	2.6	2.2	4.7	1094	1090	1199	602	70	-5	0.10	0.30
Potato starch, untreated, liquid STAam > 750 g/kg DM	329	18	46	3	21	780	17	1.7	0.8	2.1	1254	1233	1390	624	63	-59	-0.10	0.30
Potato starch, untreated, liquid STAam 600 - 750 g/kg DM	268	32	75	3	30	678	22	2.1	1.3	3.3	1133	1126	1245	592	62	-32	0.00	0.30
Potato starch, untreated, solid	451	19	22	4	14	863	2	1.1	0.7	2.3	1259	1235	1396	623	58	-77	0.10	0.30
Sugarbeet pulp, pressed, ensiled	248	77	86	8	189	10	53	1.0	9.9	4.4	1066	1067	1165	733	105	-79	1.05	0.70
Wheat yeast concentrate CP < 275 g/kg DM	259	64	261	64	33	15	143	8.1	2.0	15.6	1197	1196	1308	583	142	66	0.14	0.30
Wheat yeast concentrate CP > 325 g/kg DM	261	80	382	51	14	16	117	12.8	1.8	23.8	1185	1189	1291	539	183	144	0.09	0.30
Wheat yeast concentrate CP 275 - 325 g/kg DM	256	62	296	63	29	11	124	8.4	1.9	16.5	1203	1203	1314	567	153	89	0.15	0.30

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEM2022, 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	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Apples, fresh	157	23	26	19	65	36	642	0.7	0.6	8.1	1138	1130	1251	823	82	-114	0.60	0.55
Barley straw	884	72	43	26	423	0	0	0.9	3.4	15.1	477	521	450	389	20	-48	4.30	1.66
Bean straw (Phaseolus)	863	113	107	15	380	0	0	1.7	13.7	15.4	602	641	602	451	73	-41	4.30	1.66
Bean straw (Vicia)	840	73	80	15	470	0	0	1.7	13.7	15.4	510	554	487	408	48	-41	4.30	1.66
Beetroot	136	78	91	20	74	0	475	3.6	0.0	34.5	1084	1080	1189	749	96	-79	1.00	0.69
Cabbage (Brussels sprouts)	162	84	227	27	139	0	200	6.6	0.0	27.8	1065	1072	1156	712	106	46	1.29	0.90
Cabbage (Brussels sprouts, stem and leaves)	180	110	187	35	180	0	0	3.7	0.0	26.3	995	1007	1074	645	95	18	1.82	0.90
Cabbage (cauliflower)	72	138	295	22	111	0	150	6.0	0.0	42.5	1023	1030	1109	679	107	111	0.92	0.90
Cabbage (marrowstem)	120	130	172	35	180	0	0	2.5	0.0	23.0	969	981	1045	628	90	9	1.82	0.90
Cabbage (red/white/sav.), fresh	105	116	181	35	163	0	200	3.7	0.0	33.0	997	1007	1079	656	95	14	1.60	0.90
Cabbage (turnip cabbage), fresh	110	130	134	5	90	0	0	2.0	0.0	25.0	1013	1013	1107	686	107	-54	1.00	0.69
Cabbage (winterrape)	100	150	201	35	175	0	0	2.5	0.0	23.0	944	958	1017	606	93	34	1.76	0.90
Carrots	112	91	82	16	89	0	344	3.2	4.0	27.8	1077	1071	1182	751	93	-83	1.00	0.69
Chicory leaves, ensiled	175	341	115	20	141	0	0	0.0	0.0	0.0	435	464	434	339	12	37	1.56	1.00
Chicory leaves, fresh	156	202	189	36	133	0	0	0.0	0.0	0.0	816	835	870	523	91	32	0.93	0.92
Chicory roots, forced, clean	149	82	51	10	89	0	210	2.5	3.3	21.8	1026	1026	1122	745	78	-93	1.00	0.69
Chicory roots, not forced	200	100	65	10	60	0	110	2.2	0.0	18.4	1123	1110	1239	783	92	-94	0.80	0.69
Clover red, artificially dried	899	116	189	40	239	0	0	3.3	14.6	22.2	752	784	779	489	83	32	2.95	0.36
Clover red, ensiled	364	153	196	34	270	0	42	2.9	10.6	38.6	635	672	643	413	40	75	2.86	0.93
Clover red, fresh	130	116	208	40	218	0	0	0.0	0.0	0.0	792	822	827	502	108	38	1.60	0.98
Clover red, hay	830	100	182	35	344	0	0	3.1	0.0	27.9	607	649	602	404	84	19	4.35	1.40
Clover red, straw	830	68	100	24	476	0	0	0.0	0.0	0.0	401	445	357	302	39	-20	4.30	1.66
Corn cob silage	553	17	86	39	64	523	9	2.6	0.3	5.0	1187	1183	1302	573	68	-33	0.75	0.72
Cucumber, fresh	58	102	156	20	136	0	391	6.1	38.8	38.5	890	907	953	610	117	-35	1.00	0.55
Endive, fresh	52	164	290	22	122	0	156	5.5	0.0	74.6	942	954	1015	621	106	112	1.00	0.92

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEM2022, 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	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Field beans (Vicia faba) ensiled	326	87	178	24	292	146	1	2.7	15.2	25.9	671	709	681	427	51	44	2.52	0.90
Fodderbeets, fresh	139	95	78	10	59	0	587	2.0	1.4	22.9	1063	1056	1169	760	92	-86	1.05	0.69
Gherkin, fresh	49	84	226	21	167	0	335	0.0	0.0	0.0	882	905	937	568	146	-4	1.00	0.55
Grass hay, a) poor quality	845	89	106	28	334	6	98	3.0	5.0	34.1	660	698	670	503	53	-20	4.21	1.45
Grass hay, b) average quality	845	100	132	28	288	6	98	3.4	5.0	34.1	723	756	746	522	70	-14	3.60	1.40
Grass hay, c) good quality	845	109	170	28	244	6	98	3.9	5.0	34.1	807	835	848	559	84	8	3.02	1.35
Grass silage, a) clay soil, before 21 June	450	94	185	37	231	0	86	4.1	5.7	34.3	925	945	987	601	89	27	2.69	0.98
Grass silage, b) sandy soil, before 21 June	450	93	175	37	245	0	76	4.0	4.7	34.2	909	931	968	592	84	20	2.86	1.01
Grass silage, c) peat soil, before 21 June	450	96	201	39	224	0	80	4.2	5.3	34.1	936	956	999	600	87	40	2.60	0.97
Grass silage, d) clay soil, 21 June - 21 August	450	90	153	34	251	0	86	3.7	5.7	34.3	898	920	956	600	81	3	2.94	1.02
Grass silage, e) sandy soil, 21 June - 21 August	450	91	149	34	267	0	70	3.7	4.7	34.2	878	902	931	591	77	1	3.14	1.05
Grass silage, f) peat soil, 21 June - 21 August	450	89	178	37	252	0	65	4.0	5.3	34.1	911	933	969	596	82	21	2.95	1.02
Grass silage, g) clay soil, after 21 August	450	105	157	35	217	0	141	3.8	5.7	34.3	905	924	966	598	80	8	2.51	0.97
Grass silage, h) sandy soil, after 21 August	450	110	177	37	229	0	97	4.0	4.7	34.2	894	915	952	582	80	24	2.66	0.98
Grass silage, i) peat soil, after 21 August	450	103	191	38	218	0	99	4.1	5.3	34.1	924	944	988	596	81	34	2.53	0.96
Grass silage, j) average	450	97	174	36	237	0	89	4.0	5.2	34.1	908	929	968	595	80	19	2.76	0.99
Grass, artificially dried	889	104	153	35	249	0	108	3.7	6.0	33.8	862	886	914	581	88	-9	3.09	0.90
Grass, fresh, a) clay soil, before 21 June	165	99	219	39	197	0	124	4.2	6.4	35.4	994	1009	1070	645	110	43	1.57	0.91
Grass, fresh, b) sandy soil, before 21 June	165	98	199	38	208	0	128	4.1	5.4	35.4	975	991	1047	639	107	27	1.68	0.90
Grass, fresh, c) peat soil, before 21 June	165	98	219	39	194	0	128	4.2	5.4	36.8	1001	1016	1078	649	110	43	1.54	0.91
Grass, fresh, d) clay soil, 21 June - 21 August	165	115	205	38	202	0	131	4.2	6.4	35.4	959	975	1030	625	104	34	1.62	0.92

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEM2022, 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	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Grass, fresh, e) sandy soil, 21 June - 21 August	165	117	205	38	214	0	115	4.2	5.4	35.4	934	953	1000	610	103	34	1.74	0.92
Grass, fresh, f) peat soil, 21 June - 21 August	165	106	220	39	204	0	112	4.2	5.4	36.8	971	988	1042	629	106	45	1.64	0.91
Grass, fresh, g) clay soil, after 21 August	165	112	165	35	203	0	179	3.9	6.4	35.4	957	972	1030	640	97	2	1.63	0.91
Grass, fresh, h) sandy soil, after 21 August	165	118	195	37	214	0	127	4.1	5.4	35.4	931	949	997	612	100	26	1.74	0.92
Grass, fresh, i) peat soil, after 21 August	165	105	208	38	205	0	125	4.2	5.4	36.8	969	985	1040	633	101	35	1.65	0.91
Grass, fresh, j) average	165	108	204	38	205	0	130	4.1	5.8	35.9	964	981	1036	630	102	32	1.65	0.91
Grass/clover, silage Red clover	370	114	166	24	303	0	32	0.0	0.0	0.0	682	718	697	485	53	47	3.33	0.96
Grass/clover, silage White clover	456	121	167	33	279	0	58	0.0	0.0	0.0	773	803	807	533	62	40	3.13	0.97
Green cereals, fresh	160	80	110	35	250	230	0	3.9	0.0	29.0	890	913	946	626	75	-38	2.10	0.92
Green cereals, silage	250	80	107	35	250	207	0	3.7	3.5	27.3	926	945	990	607	54	-14	2.93	1.11
Leek, fresh	100	97	165	24	121	0	400	3.9	4.2	31.7	958	970	1034	665	102	-2	0.60	0.92
Lettuce, fresh	61	175	237	45	116	0	100	5.3	12.2	56.2	955	966	1032	587	100	69	0.60	0.92
Lucerne (alfalfa), artificially dried	903	117	172	23	314	0	47	2.9	14.9	24.4	632	671	637	459	77	18	3.94	1.40
Lucerne (alfalfa), ensiled	402	141	201	24	288	0	25	3.3	12.0	32.9	643	680	652	415	47	74	3.06	0.96
Lucerne (alfalfa), fresh	201	110	210	30	233	0	50	3.0	0.0	32.8	797	827	834	560	58	62	1.74	0.96
Lucerne (alfalfa), hay	872	101	175	20	312	0	50	2.8	12.9	27.6	623	663	625	450	87	10	3.92	1.40
Maize silage DM > 420 g/kg	435	33	70	33	162	398	13	1.9	1.5	9.5	955	976	1019	518	52	-42	1.36	1.04
Maize silage DM 300 - 340 g/kg	324	37	74	31	184	334	14	1.9	1.7	10.7	916	940	973	536	51	-38	1.56	0.80
Maize silage DM 340 - 380 g/kg	361	36	72	32	174	363	13	1.9	1.6	10.2	933	956	993	530	51	-40	1.47	0.81
Maize silage DM 380 - 420 g/kg	398	34	70	33	168	380	13	1.9	1.6	9.8	944	967	1007	525	52	-41	1.41	0.89
Oats straw	840	70	37	17	450	0	0	1.6	5.2	17.9	488	531	463	419	21	-54	4.30	1.66
Onions, fresh	118	134	135	25	115	0	275	3.0	9.4	16.5	1058	1055	1160	709	92	-23	1.00	0.90
Pea leaves, ensiled	227	169	183	26	258	0	0	3.7	0.0	21.1	629	663	640	415	34	72	3.03	1.00
Pea leaves, fresh	180	93	184	35	274	0	0	2.7	0.0	21.1	790	822	822	522	92	18	2.34	0.92

4.4 Roughage for ruminants (DM in g/kg product; VEM, VEM2022, 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	P	Ca	K	VEM 2022	VEM	VEVI	FOM	DVE	OEB	SW	VW
Pea straw	710	106	106	16	368	0	0	1.2	21.6	23.3	480	523	457	356	52	-27	4.30	1.66
Pears, fresh	165	24	16	15	146	0	558	0.4	0.8	1.2	1100	1098	1205	826	77	-118	0.60	0.55
Potato peelings, ensiled	220	80	98	12	188	485	5	2.9	0.0	27.2	1019	1025	1106	517	55	-12	0.75	0.55
Potatoes, fresh	202	57	105	3	41	627	30	2.0	0.6	22.2	1101	1097	1207	524	67	-8	0.70	0.65
Potatoes, raw, ensiled	322	74	71	1	33	536	5	2.0	0.0	11.0	1086	1079	1194	549	55	-35	0.60	0.65
Rape seed straw	849	70	38	8	523	0	0	1.1	15.6	14.1	288	327	232	269	-5	-31	4.30	1.66
Rye straw	840	70	29	16	485	0	0	1.0	0.0	10.0	438	482	404	391	12	-51	4.30	1.66
Sorghum, silage High DM content	360	44	84	25	126	335	10	1.9	2.6	14.6	893	914	951	426	41	-42	1.03	0.82
Sorghum, silage low DM content	270	50	84	25	191	248	13	2.2	2.6	16.2	808	836	848	414	37	-40	1.62	0.93
Spinach, fresh	94	186	256	37	99	0	0	6.2	9.7	62.0	943	953	1019	584	100	86	1.00	0.92
Sugarbeet leaves with tops, fresh	160	200	151	20	100	0	0	2.3	0.0	31.0	845	857	910	576	86	0	0.60	1.00
Sugarbeet leaves, fresh	115	200	182	20	110	0	0	2.3	0.0	35.0	829	844	889	559	92	24	0.70	0.92
Sugarbeet leaves, silage	182	313	126	20	137	2	1	3.1	13.9	39.3	619	640	653	384	25	39	1.51	1.00
Sugarbeet rests, ensiled	135	185	110	5	147	0	2	2.2	12.4	14.2	783	799	837	565	88	-45	1.40	0.69
Sugarbeets, fresh	260	190	41	5	45	0	600	1.6	0.0	8.0	939	931	1033	700	69	-90	0.80	0.69
Sunflower, silage	184	126	119	58	307	0	0	3.7	18.0	38.2	772	803	805	456	46	10	2.66	1.00
Sweet pepper, fresh	125	62	163	37	176	0	375	2.9	1.2	0.0	836	864	880	541	108	-22	0.60	0.55
Tomatoes, fresh	63	90	164	47	96	0	450	4.9	1.9	42.0	963	977	1037	597	120	-30	0.60	0.55
Wheat straw	878	84	41	12	418	0	0	0.9	4.3	14.8	383	425	343	344	10	-41	4.30	1.66
Whole crop silage (cereal)	325	79	122	30	248	130	14	3.0	3.7	19.4	762	794	792	489	45	1	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 VEVI, minus 35 FOM 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 NH_3 -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 NH_3 . The values presented are based on a NH_3 fraction of 10%.
- 6) DVE and OEB are calculated on the basis of CP inclusive NH_3 .
- 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. Most 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 (199?)
- 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)
- nr. 78: Body weight of Holstein Friesian cows (2022)
- nr. 79: Geactualiseerde energiebehoeftenormen voor Holstein Friesian melkkoeien (2022)

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 2022
- 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
FOM	g	Fermentable organic matter in the rumen
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
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
P	g	Phosphorus

Abbreviation	Unit	Description
%P	%	Protein content in milk
Pr	g/day	Milk protein production
S	g	Sulphur
Se	mg	Selenium
STA	g	Starch
STAam		Starch analysed with amyloglucosidase
STAew		Starch analyzed with the Ewers method (polarimetric method)
SUG	g	Sugar
SW	-	Structuurwaarde; Structure unit
TDMI	kg DM/day	Total Dry Matter Intake
VEM	-	Voedereenheid melkproductie; Feed unit milk production
VEM2022	-	Voedereenheid melkproductie; Feed unit milk production vanaf 2022
VEVI	-	Voedereenheid vleesproductie; Feed unit meat production
VW	-	Verzadigingswaarde; Fill unit
Zn	mg	Zinc